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AD B015 387

AUTHORITY:
ADC, D/A ltr
2 Sep 85

REPORT NO. SARPA-QA-X-016

INTERIM REPORT

MODERNIZATION OF CLOSED BOMB TESTING FOR ACCEPTANCE OF SINGLE BASE PROPELLANT

JOHN K. DOMEN

MAY 1976

PRODUCTION BASE MODERNIZATION OFFICE
PRODUCT ASSURANCE DIRECTORATE
PICATINNY ARSENAL
DOVER, NEW JERSEY 07801

(SUB-TASK OF MM&T PROJECT 5754186)

Report No. QA-X-016

(14) SHRH-QA-X-016

FISCAL YEAR 1975

INTERIM REPORT

ON

(6) MODERNIZATION OF CLOSED BOMB TESTING FOR ACCEPTANCE OF SINGLE BASE PROPELLANT.

(Sub-Task of MM&T Project 5754186)

(9) Interim rept.
Jul 74—Jul 75

(10) John K. Domen
May 1976

(12) 220 p.

(11) Mar 76

Production Base Modernization Office
Product Assurance Directorate
Picatinny Arsenal
Dover, N.J. 07801

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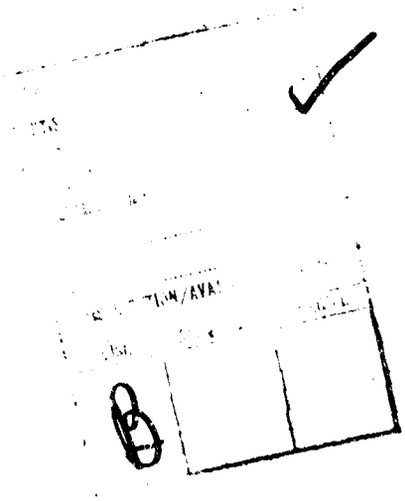

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ABSTRACT

A continuous process for propellant production in the modernization program and the need for rapid ballistic assessment of propellant prompted the US Army to authorize a three year MM&T Project 5754186, acronym (AUTOCAP), to improve and automate the current procedure for accepting propellant. A major sub-task of this development program was the automation of the conventional closed bomb. Steps taken to accomplish this sub-task consisted of: (1) a review of all closed bomb data acquisition and analysis procedures at military installations; and (2) assessment of the ability of these closed bomb methods to predict actual gun performance.

Towards this end, data from 14 special AUTOCAP single base M1 propellant lots was analyzed using the standard analysis specified in MIL-STD-286B, 801.1 i.e. Relative Quickness (RQ) and Relative Force (RF), as well as several new computerized techniques. RQ varied in these special lots from 72 to 121%.

In this report the influence of numerical methods on data is shown and comparisons are made between predicted and actual ballistic behavior.

The study reflected in this report, covering work performed between July 74 and July 75 indicates a need for (1) further standardization of the closed bomb data acquisition system in line with modern technology; (2) new methods for analyzing the closed bomb pressure signal for better correlation with ballistics; and (3) elimination of reference propellant firings in the closed bomb. These needs were determined by the scrupulous analyses of the closed bomb signal for batch produced propellant lots whose ballistic results are readily available.

It was concluded that the closed bomb test alone still appears inadequate for accurate charge weight determination at single zones. Multiple zone assessments introduce further as yet unsolvable complications.

Follow on work during FY76 is being sponsored by MM&T Project 5764302 and will be summarized in a future report.

FORWARD

The ability of the closed bomb (CB) alone to reliably predict gun charge loading for specific zone firings, although often claimed by its proponents, has never been proven and in fact is considered by most knowledgeable ordnance people to be only a gross indicator of propellant quality. In the continuous propellant production process at full production capacity, about one-quarter million pounds of propellant will be produced in a few days. It is highly desirable from the economic and logistics standpoint to load this propellant into prop charges as soon as possible after its production. This requires that lot charge weight (CW) determination be accomplished without waiting a month for the conduct of ballistic firings at an off-site proving ground. Inasmuch as full scale gun firings can not be performed at a production plant, the search for rapid on-site test devices and methods to accomplish this CW determination included a re-evaluation of the closed bomb. Although the closed bomb's pressure-time trace is quite different from that of the actual gun or howitzer (because of its lower loading density and lack of volume increase) the closed bomb does represent the only dynamic laboratory performance indicator available and as such merited a study to definitively establish its limitations and maximize its full potential.

Previously the CB has been used for propellant acceptance only during emergencies and then only to verify that set charge weights in the low accuracy 4.2 mortar were not compromised by a particular lot of propellant. Efforts on other artillery systems requiring precise charge weight determinations always met with mixed success (References 1, 2). The CB pressure trace is universally used for deriving burning rate as an input to interior ballistics calculations (References 3, 4). However, here too, ignorance of instantaneous burning surface area forces assumptions of ideality which depart from real gun conditions.

In view of its long history, and prompted by the need for a rapid propellant acceptance technique, the Modernization Office for Product Assurance at Picatinny Arsenal inquired into the hardware and computer software associated with the closed bomb at military installations. The principal effort of this study addresses the data acquisition process and suggests new methods for data analysis. A subsequent report will expand this basic study and place it in perspective with concurrent effort being expended on ballistic simulators (dynagun, scalar gun), propellant ignition (partial burner), and burning rate (high pressure acoustic burner).

To address the problem experimentally, fourteen small lots of single base M1 propellant for the 155mm, M4A2 charge were manufactured to out-of-specification tolerances on moisture, potassium sulfate, and geometry, with ballistic firings (four at zone 7 in M126 weapon, and four at zone 5). Parallel closed bomb

firings were conducted at Radford (six at 0.2g/cm^3 loading density) and at Picatinny Arsenal (Ballistics and Combustion Research Branch) (References 5, 6, 7).

The past production history of M1 propellant and the statistical linking of chemistry and geometry variations with proving ground results are not the subject of this report. Nor is the intent of this report to describe ways of mathematically extracting burn rate information from the closed bomb.

This compilation and study are offered at this point in time to interested personnel as a basis for reassessing methods of data acquisition and analysis and future standardization of closed bomb procedures, and hardware and/or software in line with modern technology. Should a change be made, some form of mathematical transfer function should be generated that can relate past closed bomb data to the new system to the best degree possible.

It is a pleasure to acknowledge the cooperation of personnel at Badger AAP, Ballistic Research Laboratory, Indiana AAP, Radford AAP, Naval Ordnance Station, and Picatinny Arsenal in supplying operating information and various data. The author assumes responsibility if any acquired information appears misrepresented.

INTRODUCTION

The object of this report is two-fold:

1. To describe closed bomb hardware and operating procedures at various installations with emphasis on the methods of data acquisition and analysis presently employed. (This summary is considered necessary in view of the divergencies in data acquisition and analysis over past years.)

2. To offer new approaches to analyzing CB data and verify the potential improvement by relating to gun firing data from the AUTOCAP program.

The closed bomb is a heavy metal walled, constant volume chamber, with a 200 cm^3 (12.2 in^3) volume used for small granulation. Forty grams of propellant are ordinarily used thereby resulting in a 0.2g/cm^3 loading density. Higher charge weight would tend to overpressure the vessel. The peak pressure normally attained is from 28,000 to 35,000 psi (depending on propellant chemistry and geometry). This pressure is in the range attained by zone 7, 155mm howitzer firings. (If loading densities were used in the CB equal to that of the gun, peak closed bomb pressure would exceed 80 kpsi due to non-expanding nature of the CB.)

It is evident that the closed bomb is not expected to predict charge loading for artillery. History is evidence to this. The lower loading density and constant volume combustion process give a pressure trace quite different from that of the gun (particularly after early stages of ignition). Furthermore, charge determination for various zones generally follows a parabolic function for howitzers (Reference 8). How the closed bomb could determine several loading zone increments when it is only fired at a singe charge density is not easily answered. Even with gun firings, assessments are made at each zone due to errors which have been observed when attempts were made to predict lower zone weights from high zone firings and vice-versa.

At this time there are three types of devices addressing dynamic propellant behavior:

(1) Closed bombs.

(2) Simulators - These are more complex in design than the CB as they allow a variable volume (not vented vessel) and approach the actual gun pressure curve more closely.

(3) Actual guns or howitzers.

A fourth indirect method which addresses propellant performance is state-of-the-art interior ballistics programs. They are now available and are being refined that calculate muzzle velocity from basic physics and propellant properties to about 1%.

There is a proposal to use the actual weapon with a frangible round (plastic shell with high density metal powder to attain same weight as the actual shell) at the production site. However, this requires a gun crew, is not a small laboratory device, and only chamber pressure data is attained with no muzzle velocity data.

A simulator or test device cannot duplicate important factors of heat loss into the metal walls, engraving, shell resistance, the ignition system, prop bag configuration, grain motion and compaction for high density loading. However, the intent of a test device is not meant to, and cannot address directly all these gun factors. It is reasonable only to expect that it assess the contribution of propellant itself to ballistic performance, though this statement needs clarification. However, if efforts show that these factors are the actual demise of any simulator, then the status quo of gun firings remains. In the reality of gun firings, temperature conditions and the gun introduce a bias in velocity as is evidenced by the common practice of adjusting muzzle velocities according to the mean of the reference propellant gun firings. It is eventually the gun which is the integrator of influencing factors showing fluctuations through pressure and velocity standard deviation.

The 14 special lots studied and the associated howitzer firings are tabulated below:

Off-Spec Lots		Closed Bomb Firings (RAD)		Ballistic Firings
J	P	J	P	(Same as closed bomb except lot LL was not fired by itself).
K	Q	K	Q	
L	R	L	R	
M	S	J L	S	
N	T	J K L	T	
LL	U	M	U	
	V	N	V	
	W	J K LL	W	
		LL		

The RQ ranged from 72 to 121%, with Radford lot 68308 for the M1A2 charge as reference. A critique is made of the current closed bomb hardware and numerical methods employed. A total of 150 closed bomb pressure records from Radford and 39 from Picatinny Arsenal were analyzed, with correlation with ballistic firings. An attempt was made to see if current methods of taking the pressure trace and numerical methods do not introduce sources of error into this basic data acquisition.

Variations arise from: (*) (References 9, 10)

1. Instrumentation (e.g. filters, transducers)

2. Ignition variations

3. Numerical procedures

4. Propellant heterogenity (if present)

Benefits offered by this work are:

1. Revision of MIL-STD-286B Method 801.1 on closed bomb for hardware standardization consistent with modern technology, and for consistent numerical methods and analysis of the pressure signal.

2. Creation of new methods for using closed bomb data to provide a better correlation with gun ballistics.

3. Use of an absolute closed bomb data source without recourse to duplicate firings of reference propellant.

---

*The Round Robin among Badger, Indiana, Radford and Sunflower in 1956 experienced RQ variations possibly due to instrumentation.

Carefully planned and controlled firings of specially manufactured propellant were conducted at 4 closed vessel installations in the U.K. in 1962. Results were rather disappointing as they disclosed appreciable differences in the measurements made by different installations, and to slightly lesser degree in measurements at each installations at different times. All installations used the same recorder, transducer, and vessel design. Readings were made of maximum pressure and of dp/dt at 9, 10, 11 tons/in^2. The charge was 140 grams in a 700cc nominal vessel with a 20 grain (1.3 gram) ignitor of gunpowder G12.

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LIST OF ABBREVIATIONS AND SYMBOLS

AF - absolute force (peak closed bomb pressure)
AQ - absolute quickness (measure of average dp/dt for test propellant)
AUTOCAP - automated continuous acceptance of propellant
CB - closed bomb
CBI - clean burning ignitor

CW - propellant charge weight
DBP - dibutylphthalate
DNT - dinitrotoluene
DPA - diphenylamine
DP/DT - time derivative of pressure

g - grams
KPSI - thousands of pounds per square inch
ms - millisecond
NC - nitrocellulose
P - pressure

PA - Picatinny Arsenal
PP - peak pressure
RAD - Radford AAP
RC - resistor, capacitor
RF - relative force (related to peak pressure)

RQ - relative quickness (related to closed bomb dp/dt)
REF - propellant from a reference lot
RQA - relative quickness with averaged references
RS - residual solvents
TV - total volatiles = RS + H_2O

TEST - propellant from lot to be tested

$\beta = 1 - \alpha = 1 - (\Delta T)/(RC_H)$

μs - microsecond
ΔT - time sampling interval
9 C - nine point least squares cubic fit

I. CLOSED BOMB DATA ACQUISITION SYSTEMS

A. Radford Army Ammunition Plant:

A.1 Closed Bomb and Circuitry

Nominal 200 (actually 192 cm^3), 700 and 2400 cm^3 bombs are located side by side in the bay area and are inclined about 15 degrees from base of operation. An external jacket provides water cooling. These are shown in Figure 1. Different sizes are used to accomodate propellant of various webs (or size) to permit a sufficient number of grains in each firing. The 200 and 700 bomb (Drawing No. 0224-0110729-T10703--5/64) are constructed with an integral one-piece design shown in Figure 2.

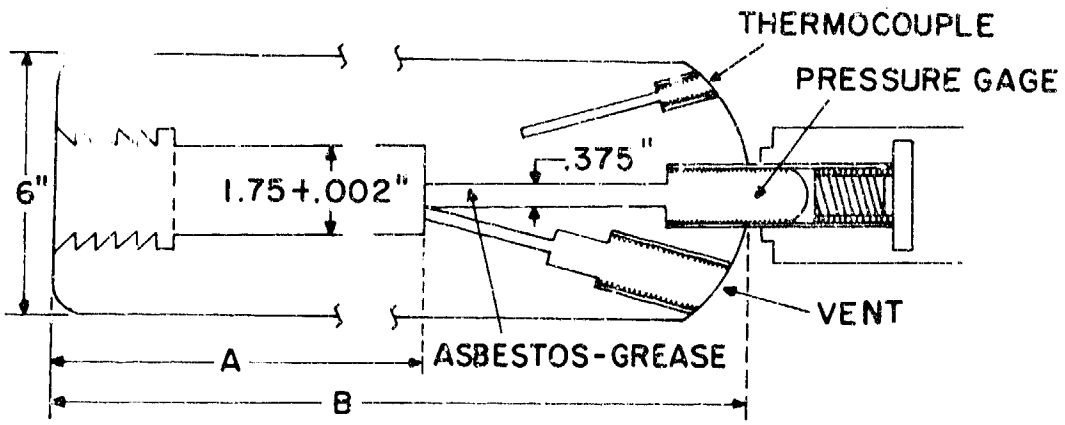


Figure 2 Closed Bomb Design

For a right cylinder, these volumes are attained with a cylinder length L:

cm^3	I.D.	L	Propellant Web		A	B
200	1.75"	5.1"	up to 0.06"	200	9.08"	13.83"
700	1.75"	17.8	0.06 to 0.1"	700	21.8"	26.55"
2400	3.5	15.2	0.1 and up			

An asbestos grease of low hygroscopic composition packs the front end of the pressure gage, and is periodically replaced. Firings are conducted for thermocouple readings of 90 + 2 F. For ignition 0.1 gram of guncotton (less than one cubic inch) is wrapped with a nichrome wire attached to the breech electrodes. Clean burning ignitor (CBI, almost pure granular nitrocellulose; one gram for the 200 cm^3; 5 for the 700; and

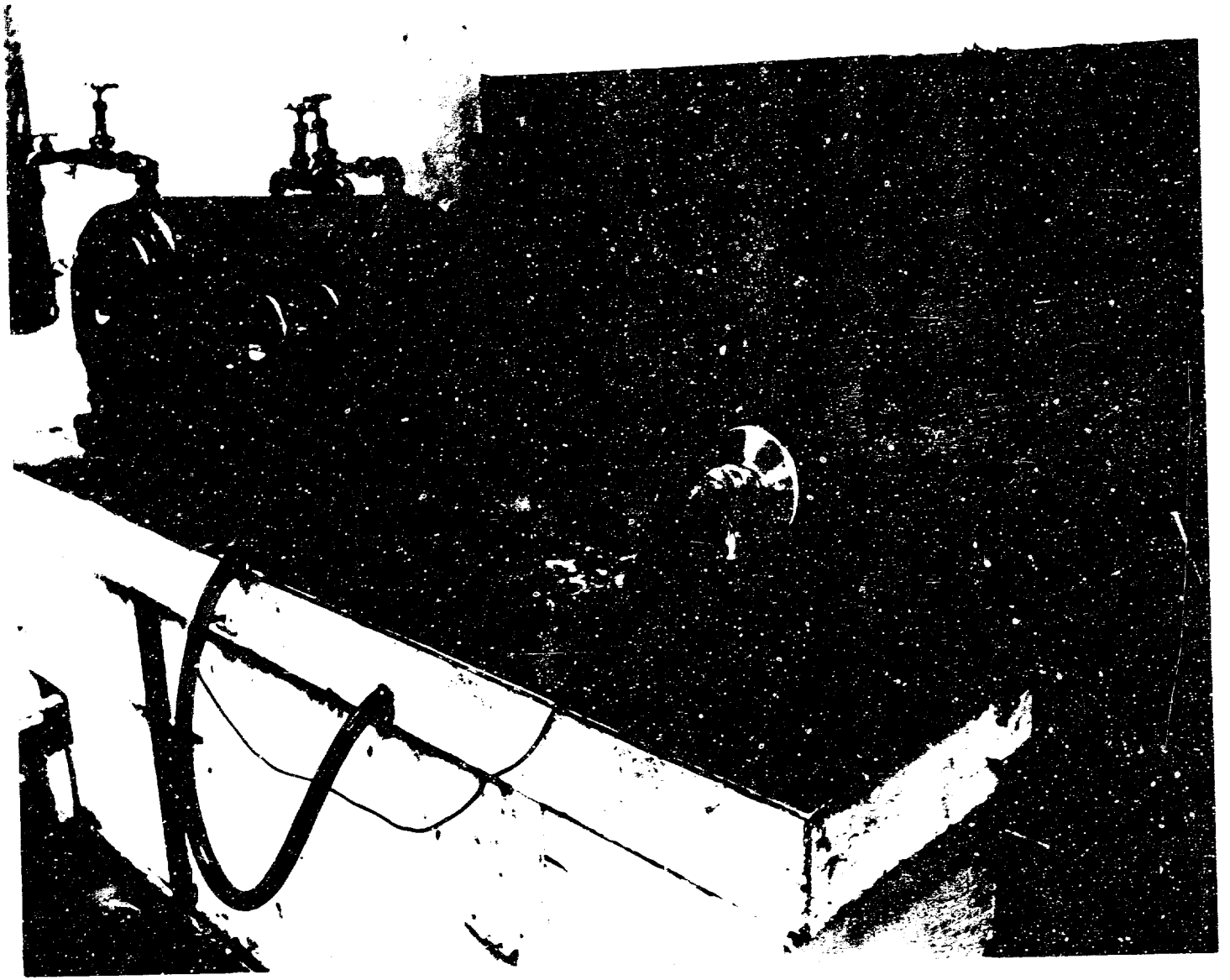


FIGURE 1 RADFORD CLOSED BOMB

15 for the 2400) is poured into a long scoop (resembling a can cut in half along its longitudinal axis) with most of the CBI at the back of the scoop for location at the bomb entrance. Test propellant is then poured uniformly along the scoop, and the scoop inserted into the bomb and inverted.

The gage is non-commercial with four x-cut quartz crystals and five steel plates. The essential features are shown in Figure 3.

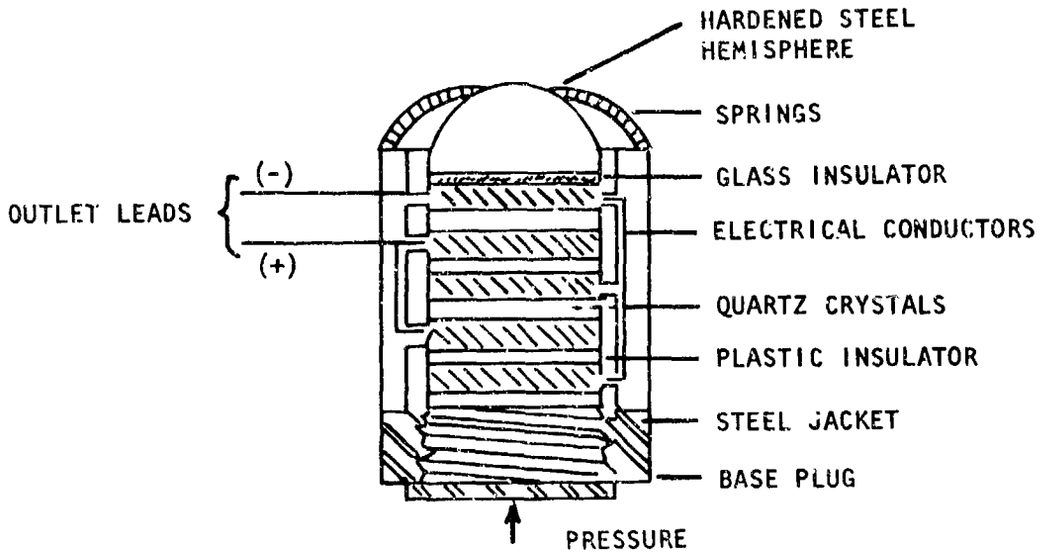


Figure 3 Radford Closed Bomb Pressure Gage

Gages are kept in a 90°F oven when not in use to prevent moisture accumulation. The gage is calibrated by deflection of a ballistic galvanometer when a dead weight load producing 30 kpsi is suddenly released, indicating a charge Q developed:

$$P = F/A = KQ/A \qquad F = KQ$$

Then a capacitor C charged to voltage V is similarly discharged through the galvanometer to determine the constant K:

$CV = Q$ When Q is equal: $K = F/(CV)$.

The essential features of the electrical circuitry for data generation and transmission are in Figure 4.

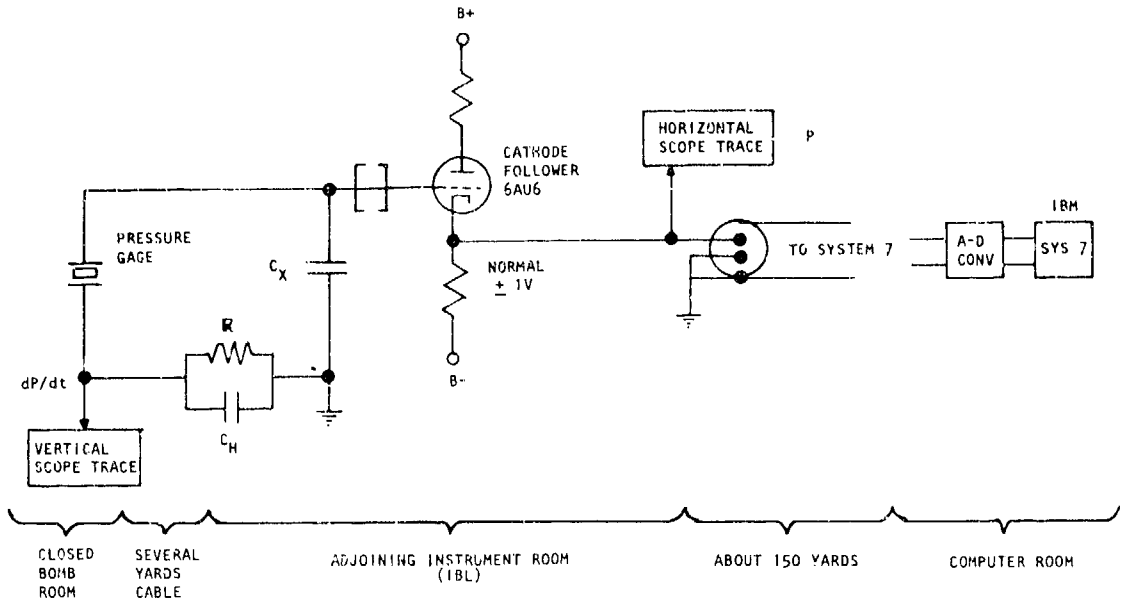


Figure 4 Radford Closed Bomb Data System

An instrument panel houses an especially built oscilloscope Model H-591 (in use since 1962), the decade resistance and capacitance boxes, DC amplifiers for the scope, camera, and calibration circuit relays. C_X, across which pressure is monitored, is available in 0.01 and 0.001 μf decade steps in parallel; R, across which dp/dt is monitored, has 1, 10, and 100 K Ω decade steps in series; C_H, the hash capacitance, is in 0.001 μf steps, and is usually set at 0.01 μf. This panel is pictured in Figure 5.

The circuitry patterns MIL-STD 286B (1 Dec. 1967).

A revised section of 30 June 1971 mentions charge amplifier, but none is employed. (A new panel presently being constructed replaces the cathode follower with a solid state device).

The pressure signal is conveyed by a short open wire system and then cable to an adjoining room where the RC network and oscilloscope are located. Just before firings, step calibration signals of nine discrete voltage levels from 0 to 2 volts in 0.25 volt increments are impressed across C_X in about 2 seconds by a switching relay. The square bracket in Figure 4 shows the line interruption point for this transmission. This transmission produces calibration lines on the polaroid for IBL (Interior Ballistic Lab), and hexadecimal stored voltage values on the IBM disc.

The cathode follower acts as impedance match, and the complete RC network is left in-line during generation of the pressure signal which is transmitted over about 125 yards of cable over poles carrying power lines. As the voltage varies from 0 to 2 volts, the follower output at the receiving end varies

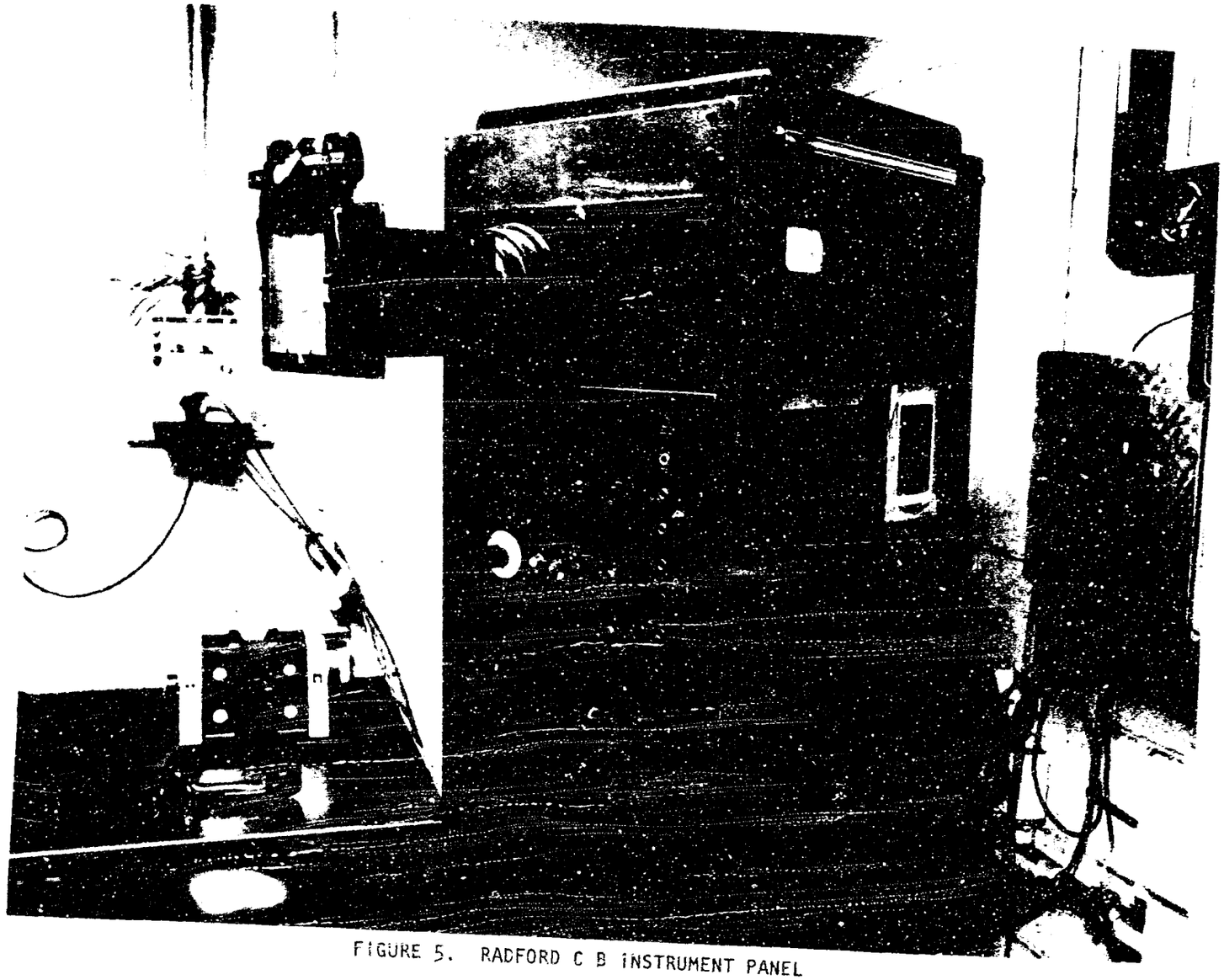
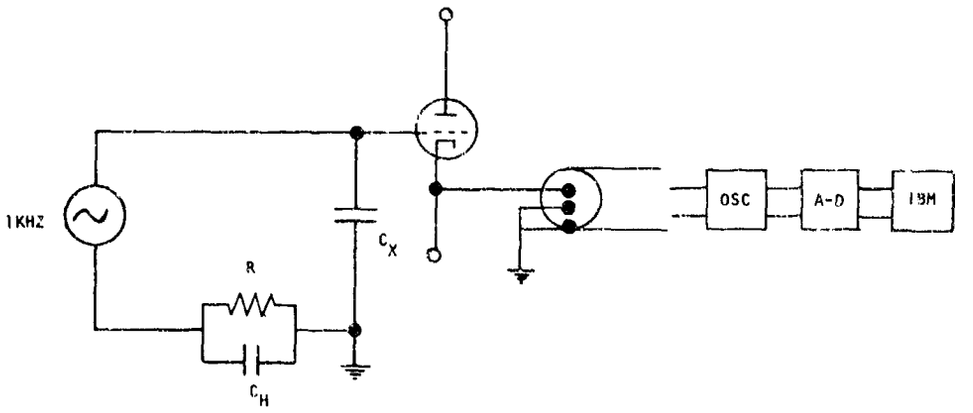


FIGURE 5. RADFORD C B INSTRUMENT PANEL

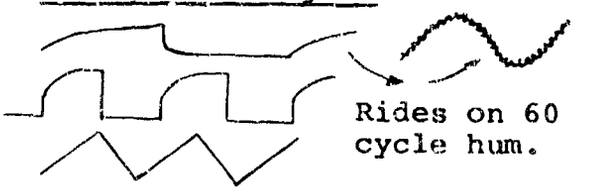
from about 1 to -0.2 volts. The signal is transmitted through a shielded twisted pair line, with the shield grounded at IBL end and open at the SYS7 end. The A/D converter has 14 bit resolution with a possible 50 μs sample time at high level.

Table 1 lists RC (resistor-capacitor) values used at Radford for various propellants, along with loading parameters. To obtain an indication of purity of signal transmission, a 1 KH_z square wave was connected into the panel by disconnecting the pressure gage leads. The output was monitored by a scope at the computer room just before entering the A/D converter (disconnected). Qualitatively, the results showed some signal distortion, and large 60 cycle hum. Three sets of RC settings were tried.



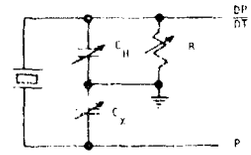
	C_X (μf)	C_H (μf)	R (kΩ)
A	0.069	0.01	93
B	0.029	0.01	93
C	0.029	0.001	93

Transmitted Signal



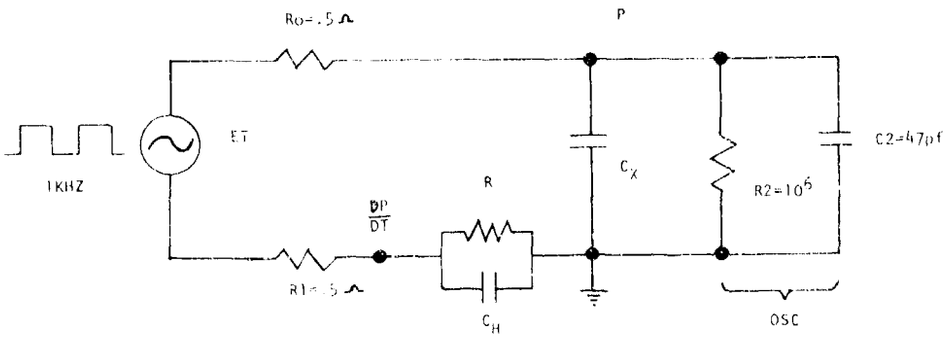
To find the influence of components other than the RC network, the circuit was simulated on a Super-Sceptre computer program with the circuit: (Reference 11 gives a closed form analysis for a similar circuit).

Table 1 RC Values in Radford Closed Bomb Data System



Computerized Closed Bomb

Propellant and Charge	Capacitance C_X [μf]	Hash C_h [μf]	Resistance R [kilohm]	Bomb Size [cm³]	Loading Density [g/cm³]	Web [in]
M1 MP 105mm M67	0.070	0.010	70.	200	0.2	0.025
M1 MP 155mm M4A2	0.069	0.010	93.	200	0.2	0.038
M1 SP 105mm M67	0.070	0.010	35.	200	0.2	0.013
M1 SP 155mm M3A1	0.070	0.010	80.	200	0.2	0.016
M30 105mm M490, M456A1	0.080	0.010	102.	700	0.2	0.054
M30 105mm M490, M456A1	0.080	0.010	85.		0.2	
M30 105mm M490, M456A1	0.032	0.010	550.	700	0.10	
M30 105mm M392A2	0.080	0.010	85.	200	0.2	0.046
M30 105mm XM724	0.078	0.010	55.	200	0.2	0.030
BS-NACO 8" 55 Cal.	0.065	0.010	400.	700	0.2	0.086
CBI, Type II	0.023	0.010	150.	200	0.075	
M181	0.021	0.010	185.	200	0.062	
M182	0.021	0.010	185.	200	0.062	
M1A1	0.024	0.010	142.	200	0.085	
M2A1	0.030	0.010	58.	200	0.085	
M36A1 F/4.2	0.032	0.010	150.	2400	0.0896	
M30A1 F/8" XM188	0.078	0.010	190.	700	0.2	0.086
M10 57mm M309	0.060	0.010	25.	200	0.2	
M26 106mm M344A1	0.024	0.010	710.	700	0.079	0.039
M26E1 (T28E1) F/152mm XM189	0.024	0.010	999.	700	0.079	0.038
M30 F/76mm M339	0.080	0.010	102.	700	0.2	0.060
M30A1 155mm XM123	0.078	0.010	150.	700	0.2	0.079
BS-NACO 5" 54 Cal.	0.062	0.010	220.	200	0.2	0.050
M9 Flake 0.003"	0.032	0.010	77.	200	0.084	
M6 105mm M327	0.071	0.010	75.	200	0.2	0.029
M6 175mm M86A2	0.069	0.010	420.	700	0.2	0.077
M6 175mm M86A2	0.045	0.010	999.	700	0.15	
M6 175mm M86A2	0.027	0.010	999.	700	0.1	
M6 175mm M86A2	0.027	0.010	400.	700	0.1	
M6 175mm M86A2	0.045	0.010	265.	700	0.15	
M6 175mm M86A2	0.069	0.010	194.	700	0.2	
M5 Flake	0.026	0.010	53.	200	0.075	
M5 F/90mm M371	0.026	0.010	53.	200	0.075	
M9 Flake F/Ctg. Ign. M3, M6	0.032	0.010	77.	200	0.084	
M9 F/4.2" Mortar	0.032	0.010	77.	200	0.084	
M36D1 SP F/XM578	0.024	0.010	800.	700		
M30 105mm XM200	0.077	0.010	95.	200	0.2	0.048
M30 35mm	0.079	0.010	45.	200	0.2	0.015
M642 76mm	0.070	0.010	145.	200	0.2	0.050
M1 MP 105mm	0.069	0.010	98.	200	0.2	
M9 MP	0.035	0.010	500.	700	0.1	



The computer voltage output across the indicated components for the first few cycles of input are sketched in Figure 6 for the three selected RC parameter groups:

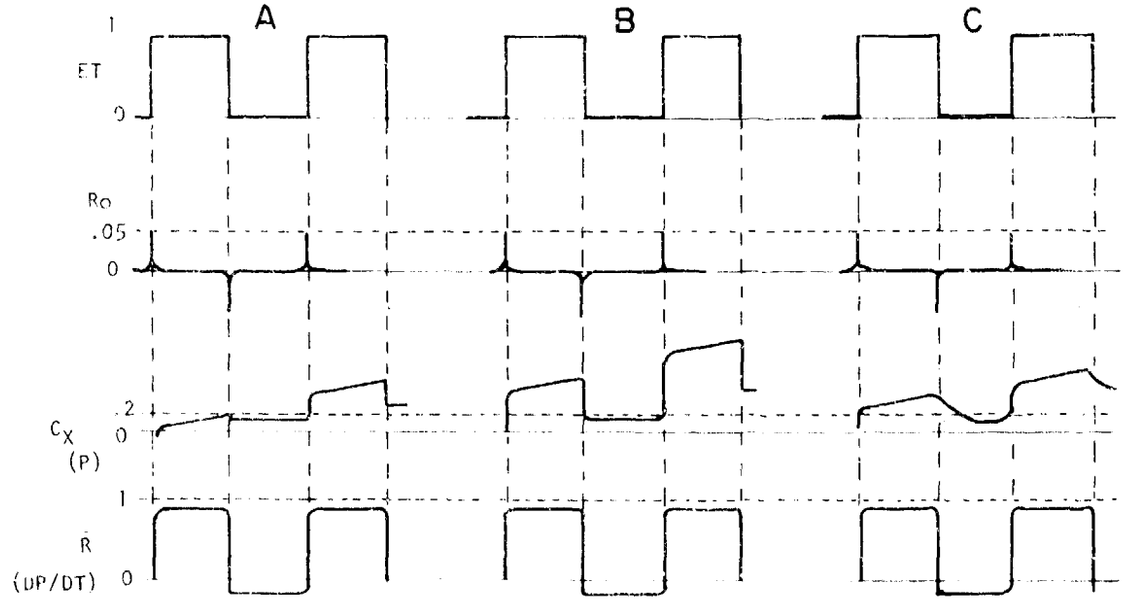
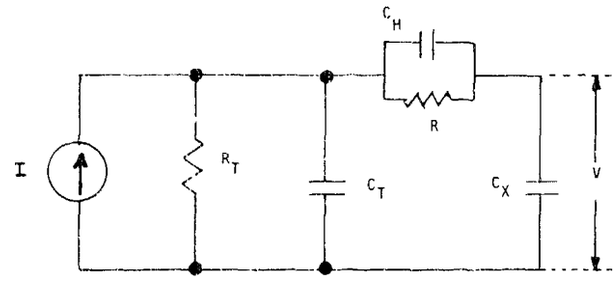


Figure 6 Sceptre Simulation of RC-One KH_z Circuit

The signal across C_X, designating the pressure, shows a qualitative agreement for cases A and B. However, the triangular form for C was observed analytically only when the hash capacitance C_H was in the low picofarad range. Further attempts were made to model the piezo crystal itself with and without the attached RC circuit to determine more exactly the actual pressure on the closed bomb walls, but lack of gage information and uncertainties in the piezo model itself prevented further inquiry into this basic approach.

With the basic relation that charge induced is proportional to force on the crystal (F = KQ), and force is pressure over the piston area (F = PA), the pressure on the gage piston is expressed as an integral over the current generated:

$$P(t) = k/A \int_0^t I(t)\, dt.$$



The measured voltage V, which is interpreted as the pressure signal, is related through the actual circuitry to the actual pressure P. Static calibration is valid if circuit time constants are negligible. (R_T and C_T refer to the transducer leakage resistance and static capacitance).

A.2 Sampling and Data Storage:

To illustrate the operation of this system, six complete disc stored hexadecimal records were acquired. (Eventually such data are erased because of storage limitation). Each record consists of the calibration step transmission and the subsequent bomb firing:

Record Number:	Test	Reference (lot 68308)
	29	26
	36	34
	45	42

Sample time was 0.2 millisecond. The complete analysis of only record 26 will be presented with Table 2 listing the hex numbers for calibration and firing. Table 3 is the decimal conversion. In the calibration transmission, the first value listed for each of the nine levels is neglected in calculating the average level. Thus the average decimal reading for zero voltage is 8969.85, and -1844.8 for the 2 volt level. The dp/dt values are calculated at calibration levels 0.5, 0.75, 1 and 1.25 volt levels (Figure 7) which here represent a decimal range from 6255.3 to 2198.3. (Radford considers each calibration point. However, for this analysis, all intermediate points are linearty interpolated between the 0 and 2 volt levels. The error is small in the eventual pressure and RQ determination).

TABLE 2. HEXADECIMAL RECORD 26 for LOT U

2940 0000 F0F2 F8F1

Calibration for Record 26

2940	0000	F0F2	F8F1	C3F7	F0F9	F5F6	F5F0
4040	4040	4040	F0F0	F2F6	230A	230A	230E
2304	2306	2308	2306	2304	230C	2304	22F6
230C	230E	230C	2308	2310	2314	2310	230E
2310	230A	1DBC	1DBE	1DBE	1D78	1DB6	1DBA
1DB8	1DC0	1DC2	1DC0	1DBC	1DBC	1DBC	1DBC
1864	186E	186E	1870	1870	1870	1870	1326
1322	131E	1322	1326	1326	1324	131E	1324
1320	0DD8	0DD6	0DDA	0DDA	0DE2	0DB8	0DD8
0DD0	0DDA	0DD8	0894	0898	0892	0894	08A2
0896	0894	0892	034A	034A	0348	034E	034E
034E	FE0E	FE12	FE10	FE12	FE14	FE14	FE1A
FE10	F8D6	F8C8	F8D0	F8CA	F8CE	F8CE	F8C6
F8CA	22F6	2302	230C	2310	230C	230E	230E
2310	2310	230A	2308	230A	230A	2308	22FC
2316	230A	2308	2306	230A	230C	2312	230E

Firing for Record 26

2940	0001	22EC	FBA0	FB94	FB94	FB90	FBB2
FB94	8000	21F2	21FC	21D6	21D6	21C8	21A8
21A4	217A	2174	215E	2136	212E	2112	20E8
20D2	20AC	209A	2074	2040	2026	200A	1FD4
1FAC	1F64	1F3C	1EF6	1EA0	1E5A	1DF0	1DA0
1D44	1CD0	1C74	1C00	1B7C	1B0C	1A80	1A14
1984	18E0	185C	17B4	1708	1664	159E	14F4
1432	1350	1280	118A	10AC	0FB0	0EA0	0DB8
0C5A	0B1E	09E2	087C	071E	0598	0406	027E
0110	FFCE	FEB2	FDC6	FD20	FC9C	FC30	FBDC
FBA6	FB88	FB6A	FB58	FB58	FB4C	FB4A	FB50
FB4C	FB42	FB50	FB46	FB4A	FB4C	FB4C	FB54
FB4E	FB56	FB58	FB56	FB56	FB58	FB5C	FB5E
FB62	FB5E	FB64	FB68	FB68	FB6C	FB62	FB6E
FB60	FB72	FB88	FB72	FBAE	FB76	FB62	FB7E
FB80	FB84	FB88	FB88	FB88	FB90	FB8A	FB92

TABLE 3. DECIMAL CONVERSION OF RECORD 26.

Calibration for Record 26

--	--	--	--	--	--	--	--
--	--	--	--	--	8970	8970	8974
8964	8956	8969	8966	8964	8972	8964	8950
8972	8974	8972	8968	8976	8980	8976	8974
8976	8970	7612	7614	7614	7544	7606	7610
7608	7616	7618	7616	7612	7612	7612	7612
6244	6254	6254	6256	6256	6256	6256	4902
4898	4894	4898	4902	4902	4900	4894	4900
4896	3544	3542	3546	3546	3554	3512	3544
3536	3546	3544	2196	2200	2194	2196	2210
2198	2196	2194	842	842	840	846	846
846	-498	-494	-496	-494	-492	-492	-486
-496	-1834	-1848	-1840	-1846	-1842	-1842	-1850
-1846	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--

Firing for Record 26

--	--	8940	-1120	-1132	-1132	-1136	-1102
-1132	ENDF	8690	8700	8662	8662	8648	8616
8612	8570	8564	8542	8502	8494	8466	8424
8402	8364	8346	8308	8256	8230	8202	8148
8108	8036	7996	7926	7840	7770	7664	7584
7492	7376	7284	7168	7036	6924	6784	6676
6532	6368	6236	6068	5896	5732	5534	5364
5170	4944	4736	4490	4268	4016	3744	3512
3162	2846	2530	2172	1822	1432	1030	638
272	-50	-334	-570	-736	-868	-976	-1060
-1114	-1144	-1174	-1192	-1192	-1204	-1206	-1200
-1204	-1214	-1200	-1210	-1206	-1204	-1204	-1196
-1202	-1194	-1192	-1194	-1194	-1192	-1188	-1186
-1182	-1186	-1180	-1176	-1176	-1172	-1182	-1170
-1184	-1166	-1144	-1166	-1106	-1162	-1182	-1154
-1152	-1148	-1144	-1144	-1144	-1136	-1142	-1134

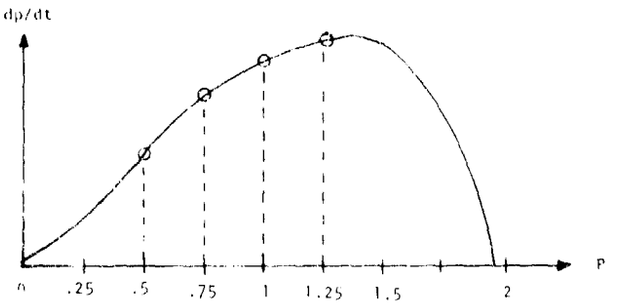
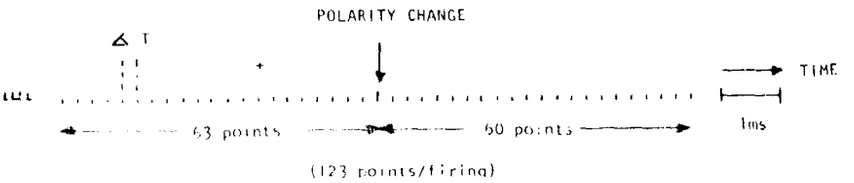


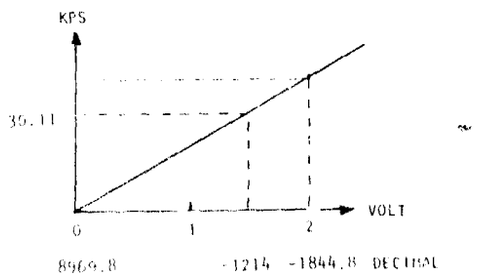
Figure 7 Four dp/dt Values for RQ

Just before firing, the computer searches the line voltage every millisecond for a voltage rise for two consecutive time intervals. Once this criterion is met, the computer records the voltage level in a wrap-around table of 123 points at a fixed sample time: 100 microseconds for fast burning powder; or 200, 300, or 400 can be selected before firing. Only 63 data points are retained before the voltage sign change from the electronic isolation stage:



For this firing, the peak pressure was reported as 30.11 kpsi at a -1214 decimal reading. The 0 and 2 volt levels result in a pressure decimal relation:

$$KPSI_{(26)} = 0.002957\ (8969.9 - D)$$

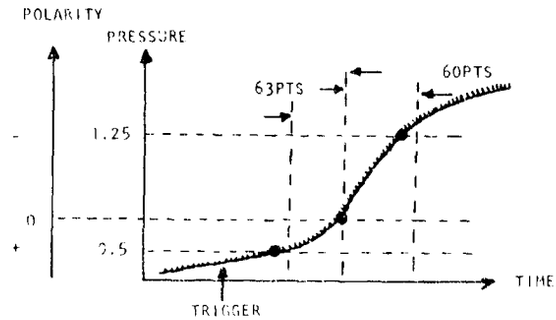


These records will be plotted in the next section on numerical methods.

In some of the firings of the P-W lots, two anomalies were noted: (1) An RQ near 150 was calculated. This was found due to loss of the first voltage calibration level in transmission, causing a shift in scaling, and was undetected by the system. (2) A consistent discrepancy occurred between IBL (hand cal-

culation from polaroid) and IBM (computer reduction) RQ values not near 100%. If the sampling rate was too fast, the 0.5 level could be missed completely. IBL values were higher than the computer ones at higher RQ, and lower at lower RQ.

Better agreement between IBL and IBM RQ values resulted when a 0.2 ms sample rate was used for lots P to W. For example for lot U with 0.1 ms rate, the RQ was about 53%; whereas a 0.2 ms rate gave 73% in close agreement with IBL value. It appears this can be explained by the method used to take data in Radford program by qualitatively considering the digitized pressure trace:



Since only about 60 points are stored on either side of the polarity change, when the sample rate is reduced from 0.2 to 0.1 ms, only about half of these points possible for 0.2 ms sampling are stored. Inspection of the original decimal output of the converter for record 29 (lot U) for a 0.2 ms rate indicated that a 0.1 ms rate would result in a first data point of about 6100, converting to 8.5 kpsi. However, the first pressure calibration point (at 0.5 volt) is located at 7.992 kpsi. (The reference record 26 with 0.1 ms rate would have a first data value of 7370 with conversion to 4.7 kpsi). Thus the faster rate for record 29 would have resulted in the LOSS OF THE FIRST REFERENCE POINT, and computer calculation verified that a lower RQ would be obtained, as was reported. The larger 0.2 ms intervals step far enough backward to include the first pressure calibration. A linear interpellation between these larger steps still obtained an RQ close to the IBL value. Table 4 shows the effect of sample rate and the need for a sufficient number of data points or an internal check to assure covering the pressure range of interest.

Table 4 Sample Rate Effect

Data point	—Reference 26— First	Last	——Lot U, 29—— First	Last	
ΔT= 0.1 ms	7370	-1188	6100	-696	Decimal
	4.7	30.08	(8.5)	28.6	kpsi conversion
ΔT= 0.2 ms	8690	-1132	8272	-620	Decimal
	0.83	29.9	2.07	28.4	kpsi conversion

Calibration voltage:		0.5	0.75	1.0	1.25
Calibration pressure: (kpsi)	26:	7.995	11.993	15.99	19.99
	29:	(7.992)	11.988	15.98	19.98

Table 5 summarizes reported average RQ and RF values by Radford for AUTOCAP lots A through W. (Lots A through H were M6 propellant for 175mm gun produced earlier). Standard deviations are listed, when available. The averages are based on six original RQ values.

Designation I, II, III represents the time when data was made available:

	Pressure sample time (millisecond)
I - early 1974	0.1
II - late 1974	0.1
III - early 1975	0.2

UNF, FIL, and IBL represent three separate calculations for RQ:

UNF - smoothed pressure data used with $\beta = 0.5$
(FIL) - smoothed pressure data with simulation of RC circuit for β.
IBL - interior ballistics lab hand calculation from polaroid.

SY7 and IBL re two separate values for RF:

(SY7) - locating peak pressure from digitized pressure data.
IBL - locating peak pressure from polaroid trace visually.

The above circled values are the reported RQ and RF values.

All AUTOCAP lots (A-W which include M6 propellant for the 175mm gun and M1 for the 155mm howitzer) were fired with the 0.2 ms sample time. Since the M6 propellant (lots A-H) were fired almost exactly one year earlier, these two sets of RQ data for M6 are plotted against the mean (of 3 firings each) of zone 3 firing in Figure 8.

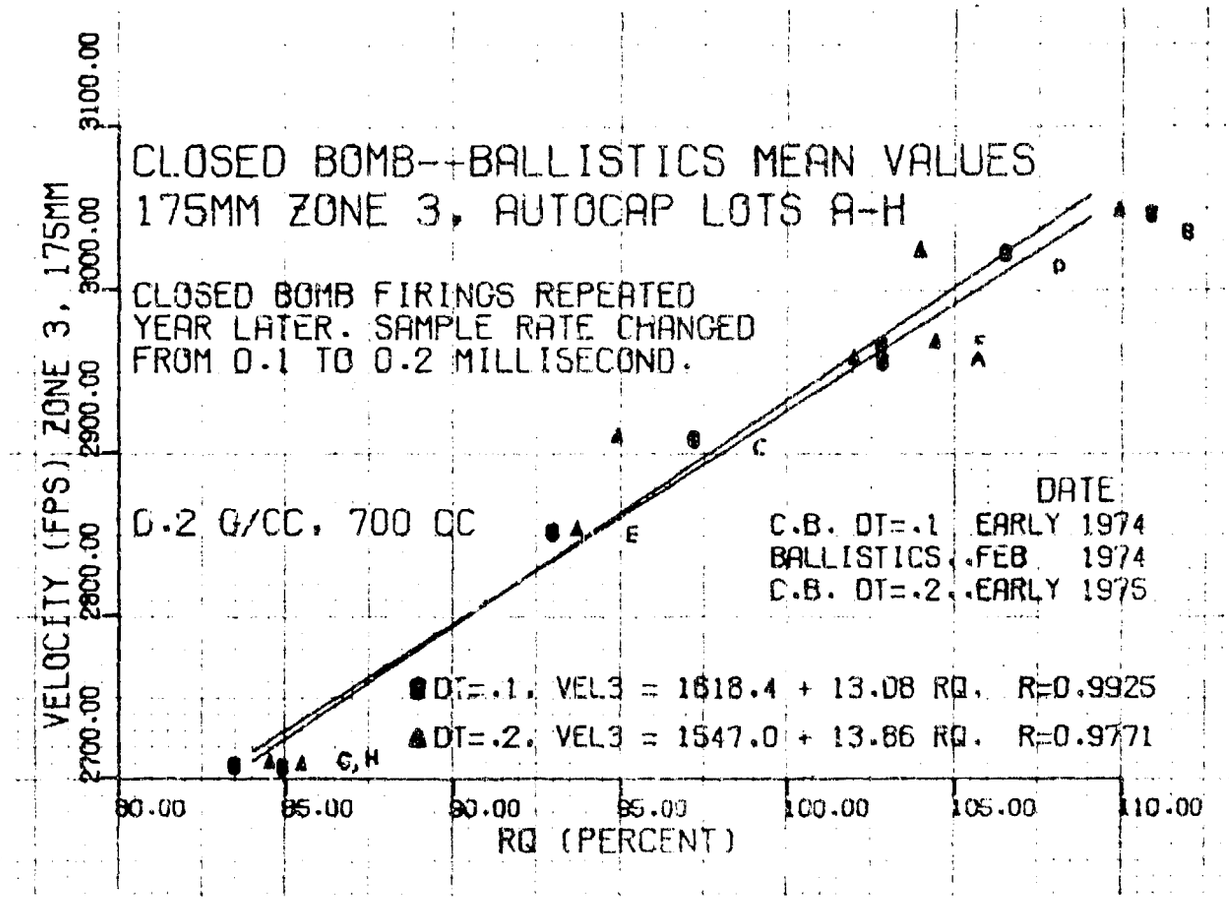


Figure 8 Closed Bomb M6 Firings Year Apart

Table 5 Radford RQ, RF Values for AUTOCAP Lots

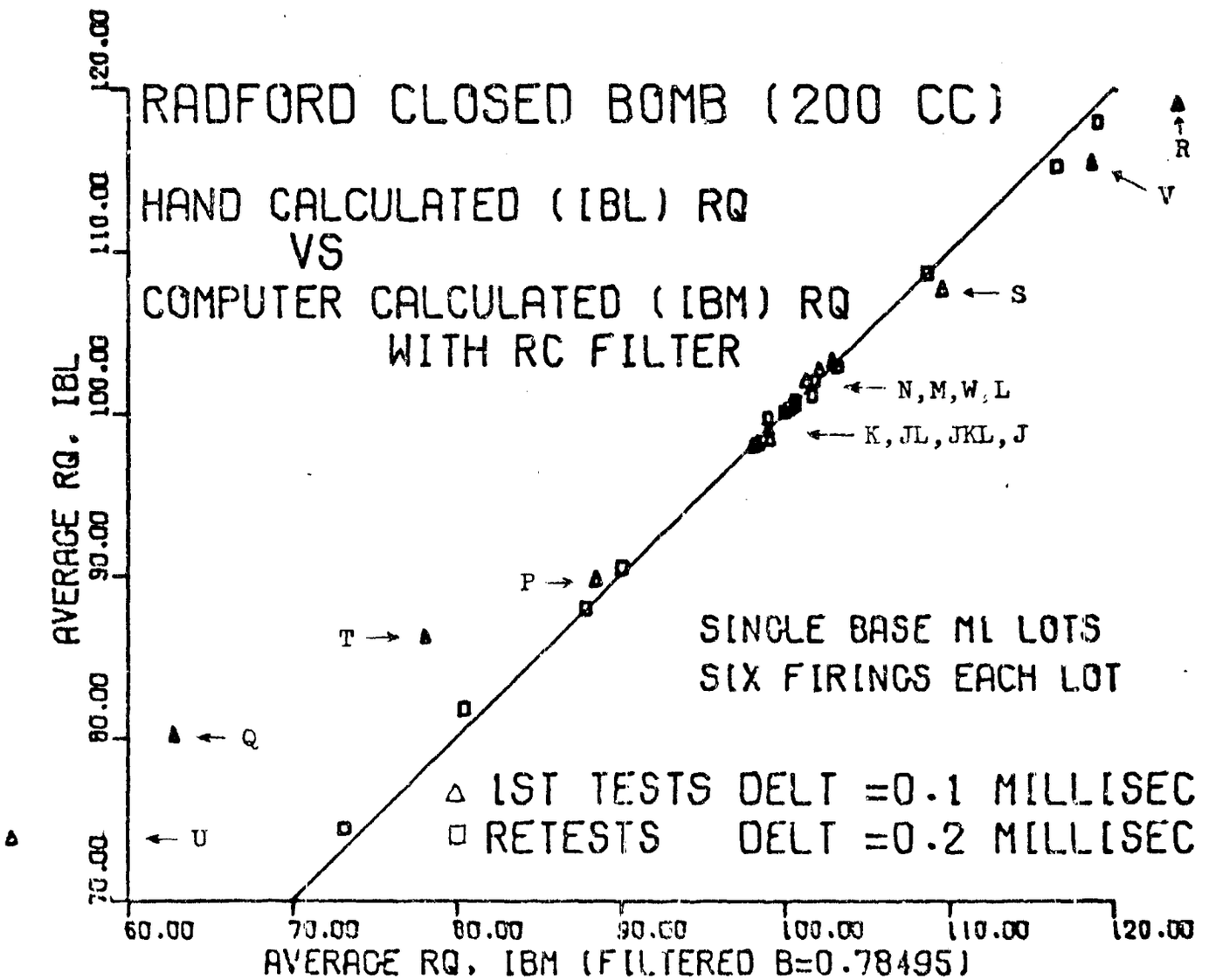
	I	II	III		I	II	III
	A				E		
UNF	102.95 (3.11)		101.73 (1.474)		91.15 (1.62)		92.51 (1.855)
FIL	102.80 (1.57)		101.96 (1.063)		92.92 (0.92)		93.68 (1.163)
IBL	101.78 (0.63)		102.50 (1.068)		93.31 (0.94)		94.79 (1.32)
SY7	100.98 (0.70)		100.63 (0.356)		99.79 (0.36)		100.33 (0.683)
IBL	101.12 (0.37)		100.67 (0.033)		99.39 (0.27)		100.11 (0.49)
	B				F		
UNF	111.38 (2.35)		110.87 (1.449)		102.60 (2.64)		104.28 (2.427)
FIL	110.82 (0.98)		109.86 (1.301)		102.76 (1.56)		104.38 (1.251)
IBL	109.05 (0.58)		109.73 (0.875)		102.72 (0.85)		104.20 (0.96)
SY7	102.03 (0.73)		101.89 (0.504)		101.23 (0.31)		102.02 (0.232)
IBL	102.38 (0.57)		101.90 (0.679)		100.89 (0.37)		102.01 (0.43)
	C				G		
UNF	101.04 (2.78)		94.210 (1.423)		81.87 (1.54)		83.22 (0.038
FIL	97.16 (1.54)		94.84 (0.547)		83.42 (1.01)		84.49 (0.55)
IBL	97.32 (1.28)		95.53 (0.674)		84.41 (1.23)		84.77 (1.10)
SY7	100.72 (0.36)		100.36 (0.152)		95.26 (0.52)		96.32 (0.71)
IBL	100.54 (0.26)		100.46 (0.256)		95.12 (0.51)		96.59 (0.87)
	D				H		
UNF	107.43 (4.34)		103.64 (2.402)		82.51 (1.37)		83.77 (1.608)
FIL	106.47 (2.46)		103.92 (1.417)		84.89 (1.19)		85.44 (0.914)
IBL	105.64 (1.62)		104.56 (1.470)		85.89 (1.33)		85.77 (1.31)
SY7	102.05 (0.25)		101.438 (0.185)		95.08 (0.30)		95.70 (0.78)
IBL	101.68 (0.36)		101.33 (0.0)		95.22 (0.42)		95.66 (1.13)

	I	II	III	I	II	III
	J			JKL		
UNF	102.17	97.34 (1.64)	102.17 (0.65)	99.16	97.78 (1.35)	100.39 (0.87)
FIL	101.12	98.07 (1.12)	101.65 (0.35)	98.91	98.11 (0.85)	99.98 (0.65)
IBL	99.71	97.83 (1.21)	100.96 (0.57)	98.91	97.80 (0.57)	99.95 (0.33)
SY7	100.44	100.92 (0.27)	102.29 (0.61)	99.56	100.14 (0.79)	99.90 (0.81)
IBL	98.42	100.79 (0.67)	102.39 (0.39)	99.56	100.26 (0.91)	100.23 (0.93)
	K			M		
UNF	100.46	99.09 (1.76)	101.50 (0.84)	101.03	102.41 (1.37)	98.00 (1.77)
FIL	100.08	98.97 (1.11)	100.66 (0.63)	101.44	102.07 (1.00)	98.94 (1.42)
IBL	99.05	98.83 (1.18)	100.60 (0.89)	101.42	102.53 (1.21)	99.51 (0.95)
SY7	100.29	100.98 (0.30)	100.37 (0.51)	100.80	101.40 (0.85)	100.66 (0.51)
IBL	99.32	100.91 (0.55)	100.23 (0.83)	100.69	101.27 (0.81)	100.57 (0.66)
	L			N		
UNF	100.99	98.40 (1.14)	101.04 (0.94)	104.12	103.66 (1.32)	102.16 (1.09)
FIL	100.55	99.10 (1.61)	100.63 (0.75)	102.81	102.88 (0.34)	101.85 (0.56)
IBL	98.64	98.26 (0.95)	100.37 (0.45)	103.10	103.09 (0.38)	101.84 (0.56)
SY7	99.55	99.93 (0.56)	99.99 (0.54)	101.59	101.65 (0.75)	101.21 (0.66)
IBL	98.67	99.65 (0.82)	100.13 (0.79)	101.60	101.37 (1.07)	101.48 (0.67)
	JL			LL		
UNF	98.15	98.65 (2.59)	100.62 (0.69)			97.32 (1.80)
FIL	93.39	98.42 (1.71)	100.30 (0.60)			97.40 (1.70)
IBL	98.41	97.94 (1.35)	100.14 (0.97)			97.48 (1.53)
SY7	98.98	99.72 (1.13)	100.20 (0.44)			98.68 (0.69)
IBL	98.89	100.24 (1.03)	100.34 (0.38)			98.85 (0.73)
				JKLL		
						98.37 (2.36)
						98.43 (2.19)
						98.57 (1.57)
						99.67 (0.46)
						99.90 (0.80)

	I	II		III		I	II		III	
	P					T				
UNF		88.50	(2.01)	89.01	(1.41)		83.84	(2.17)	85.69	(0.98)
FIL		88.47	(2.02)	90.10	(1.08)		76.15	(2.03)	87.93	(0.81)
IBL		89.57	(1.80)	90.28	(0.82)		86.03	(1.08)	87.78	(0.41)
SY 7		100.85	(0.51)	100.73	(0.90)		97.96	(0.74)	98.33	(0.63)
IBL		100.69	(0.48)	100.66	(0.59)		97.86	(0.66)	98.23	(0.33)
	Q					U				
UNF		71.21	(3.56)	78.39	(0.76)		53.06	(1.18)	70.81	(0.65)
FIL		62.84	(2.47)	80.50	(0.85)		52.98	(0.58)	73.19	(0.58)
IBL		79.94	(1.05)	81.58	(0.64)		73.72	(0.71)	74.26	(0.48)
SY7		98.55	(0.72)	99.62	(0.53)		94.62	(0.64)	95.06	(0.96)
IBL		98.64	(0.79)	99.67	(0.55)		94.72	(0.65)	95.03	(1.15)
	R					V				
UNF		124.06	(2.52)	121.57	(1.98)		118.17	(3.05)	118.02	(2.65)
FIL		123.83	(2.68)	118.96	(1.39)		118.65	(1.72)	116.50	(1.99)
IBL		118.83	(2.18)	117.76	(1.20)		115.24	(0.89)	115.03	(1.69)
SY7		101.80	(0.86)	102.86	(0.88)		99.80	(0.76)	99.60	(1.04)
IBL		101.75	(0.73)	103.19	(0.67)		99 78	(0.72)	99.57	(0.90)
	S					W				
UNF		107.71	(1.36)	109.02	(1.99)		101.44	(3.88)	102.86	(2.02)
FIL		109.20	(0.98)	108.60	(1.55)		101.29	(1.98)	103.30	(1.77)
IBL		107.47	(0.86)	108.48	(1.67)		101.83	(1.09)	102.72	(1.63)
SY7		100.02	(0.55)	100.28	(1.29)		97.22	(0.98)	97.99	(1.19)
IBL		100.02	(0.62)	100.23	(1.00)		97.05	(1.04)	98.15	(1.27)

It is interesting to note that although there is a high linear correlation coefficient (0.9925) for the earlier RQ values (mean of 6 firings/lot), the relation becomes poorer (0.9771) when fired in the CB a year later. The final conclusion cannot be drawn from Figure 8 since ballistic firings were not repeated at the time of the second CB firings, and it is unknown whether the propellant ballistic performance would have tracked with the changes in RQ mean values. Furthermore, the 0.2 ms rate should have provided a better RQ estimate.

(Lots A-H were principally changes in chemistry, while lots J-W included also changes in geometry of the grain).



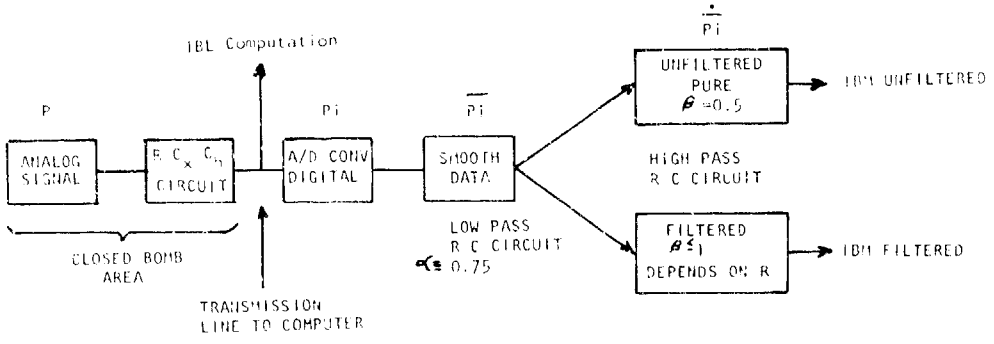
A.3 Numerical Methods

Three values for RQ are calculated by RAAP:

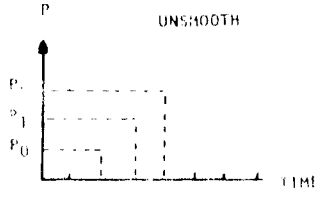
IBL Computation (Interior Ballistic Lab from polaroid),
IBM Unfiltered (IBM System-7 computer from digitized pressure),
IBM Filtered (IBM System-7 computer from digitized pressure).

The IBL computation requires visual observation of 4 points from each polaroid dp/dt vs p trace. The two IBM values are obtained by using mathematical properties of RC filters to both smooth and differentiate the pressure trace. The IBL method is a direct electronic way of obtaining a dp/dt vs p trace, but subsequent RQ calculation from the traces is time consuming (Table 23). IBM values are available within seconds after firing (Table 22).

The block diagram illustrates the locations of the three RQ determinations:



The physical R, C_X, C_H circuit is left in-line for the pressure transmission resulting in signal filtering before arriving at the A/D converter. The digitized pressure points P_i are then smoothed by an algorithm simulating properties of an RC low pass filter; where α represents the fractional voltage increase to the new step function in an interval ΔT, with a decay from the previous level:



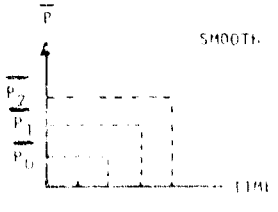
$$\overline{P_0} \equiv P_0$$

$$\overline{P_1} = \alpha P_1 + (1 - \alpha)\ \overline{P_0}$$

$$\overline{P_2} = \alpha P_2 + (1 - \alpha)\ \overline{P_1}$$

$$\overline{P_3} = \alpha P_3 + (1 - \alpha)\ \overline{P_2}$$

$$\vdots$$



$\alpha \equiv \Delta T/(RC) \equiv 0.75$ for all data smoothing.

The derivative $\overline{P}'$ is then taken by approximate simulation of an RC high pass filter (reflecting instantaneous rise to new level and discharge from the old):

$$\overline{P}'_0 \equiv 0$$

$$\overline{P}'_1 = (\overline{P_1} - \overline{P_0})/\Delta T + \beta \overline{P}'_0$$

$$\overline{P}'_2 = (\overline{P_2} - \overline{P_1})/\Delta T + \beta \overline{P}'_1$$

$$\overline{P}'_3 = (\overline{P_3} - \overline{P_2})/\Delta T + \beta \overline{P}'_2$$

For unfiltered RQ, β taken as 0.5.

For filtered RQ, $\beta = 1 - \alpha$ where $\alpha \equiv$ (sampling interval/(RC_H)).

For 0.2 ms sampling, R = 93 kΩ, and C_H = 0.01 μf:

$\alpha = \Delta T/(RC_H) = 0.0002/(93000 \times 10^{-8}) = 0.21505$; $\beta = 1 - \alpha = 0.78495$

Note the derivative is a local two point slope, enhanced by a beta fraction of the PREVIOUS derivative. The R and C_H values in the bomb circuit (Table 1) are used in this filtering, but not the C_X value. This method (smoothing with α = 0.75, and differentiating with β = 0.78495) was used in plotting records 26 and 29 in Figure 8. The reference pressures, and the derivative (with β = 0.78495) at these references for all six records are:

	KPSI				PSI/MICROSECOND				
#	0.5	0.75	1.0	1.25	0.5	0.75	1.0	1.25	Volt
26	7.995	11.993	15.990	19.988	8.827	12.429	15.722	20.126	
29	7.992	11.988	15.984	19.980	6.348	8.650	11.528	14.676	
34	7.995	11.993	15.990	19.987	9.121	12.516	16.238	20.156	
36	7.995	11.993	15.990	19.987	13.405	17.315	21.464	25.583	
42	7.994	11.991	15.988	19.984	8.991	12.413	16.113	20.064	
45	7.990	11.985	15.980	19.975	8.462	12.156	15.990	19.981	

Slight differences occur in RQ with small changes in the reference pressures:

Record:	RQ[a]	RQ[b]	RQ[c]
29/26	72.03	71.94	71.96
36/34	149.73	136.10	136.09
45/42	97.77	97.72	97.79

a Radford reported RQ using entire calibration signal.
b RQ using linear interpolation between 0 and 2 volt

calibration signal.
c RQ using 8, 12, 16, 20 kpsi as reference pressures.

The teletype output of the computer calculated RQ and RF for the six records relayed back to the closed bomb instrument room is illustrated:

1974 0346 1 4 69 093 002

SAMPLE	TIME	RECORD	RQ1 Unfiltered	RQ2 Filtered	RF
R1	09:56	0026			
L1	09:57	0027	119.8703	116.5813	102.3077
L2	09:59	0028	79.8720	80.5621	99.3142
L3	10:00	0029	69.9321	72.0328	95.2101
R2	12:43	0034			
L1	12:45	0035	96.2053	96.2334	99.8011
L2	12:46	0036	150.5829	149.7347	100.4987
L3	12:47	0037	96.0440	96.5643	100.0114
R1	12:56	0042			
L1	12:58	0043	96.5203	96.5795	99.6456
L2	13:00	0044	101.7402	00.7770	99.9941
L3	13:01	0045	98.2563	97.7705	99.6853

Use of different betas, comparing standard against standard:

Table 6 summarizes calculation of RQ using the Radford method. Though the betas have marked influence on the magnitude of the derivative, the influence on RQ is small. ($\beta = 0$ is equivalent to a simple 2 point slope derivative). Also the three reference firings were vied with each other. An RQ variation of almost 2 percent was present here.

Table 6 Influence of BETA on RQ

	TEST/REF			REF/REF		
Beta	29/26	36/34	45/42	34/26	42/26	42/34
0.	69.90	140.45	99.67	106.87	103.60	97.00
.1	69.65	140.02	99.19			
.2	69.51	139.55	98.81			
.3	69.48	139.05	98.51			
.4	69.56	138.53	98.27			
.5	69.78	137.99	98.07	103.23	101.84	98.65
.6	70.16	137.40	97.91			
.7	70.84	136.73	97.78			
.78495	71.94	136.10	97.72	101.87	100.97	99.13
.8	72.23	136.00	97.72			
.9	76.05	135.81	97.98			
1.0	89.13	139.56	99.27	100.21	100.25	100.04

Six other methods were employed for smoothing and differentiating:

9 point smooth, Cubic fit least squares = 9C
9 point smooth, Quadratic fit least squares = 9Q
19 point smooth, Cubic fit least squares = 19C
19 point smooth, Quadratic fit least squares = 19Q
3 point average smooth, Stirling = 3S
5 point average smooth, Stirling = 5S

The average smooth (last two) is an elementary method:

$$\overline{P_o} = (P_{-n} + P_{-n+1} \ldots + P_o + P_1 + \ldots + P_{n+1})/(2n+1) .$$

The Stirling method uses four adjacent points:

$$\overline{P_o}' \simeq (\overline{P}_{-2} - 8\,\overline{P}_{-1} + 8\,\overline{P}_1 - \overline{P}_2)/(12\,\Delta T)$$

Table 7 lists the derivatives (psi/microsecond) at four pressure references and compares them with Radford's approach when $\beta = 0$ (simple two point slope) and $\beta = 0.78495$. Linear interpolation is used.

Table 7 Derivatives by Numerical Methods

Derivative (psi/μs) at reference pressures 8, 12, 16, 20 kpsi:

Record	Method	8	12	16	20
26	9C	2.303	3.210	4.218	5.183
	9Q	2.292	3.192	4.221	5.256
	19C	2.310	3.216	4.305	5.457
	19Q	2.318	3.265	4.271	4.791
	3S	2.285	3.258	4.211	5.198
	5S	2.307	3.184	4.220	5.211
	Rad $\beta = 0$	2.081	3.157	3.678	5.146
	Rad $\beta = .78495$	8.832	12.435	15.737	20.14
29	9C	1.494	2.096	2.867	3.699
	9Q	1.494	2.125	2.913	3.686
	19C	1.507	2.168	2.960	3.824
	19Q	1.516	2.163	2.941	3.495
	3S	1.489	2.082	2.874	3.679
	5S	1.480	2.120	2.893	3.690
	Rad $\beta = 0$	1.566	1.981	2.680	3.534
	Rad $\beta = .78495$	6.357	8.654	11.54	14.695

The influence of numerical methods is illustrated in Table 8.

There is a small influence of about a percent for RQ near 100%.

Table 8 Numerical Method Influence on RQ

	TEST/REF		REF/REF
METHOD	29/26	45/42	42/26
9C	67.38	98.32	99.92
9Q	67.72	97.71	100.17
19C	67.87	97.34	100.87
19Q	68.36	97.46	100.60
3S	67.02	97.66	99.93
5S	67.53	97.83	99.86
Rad β = 0	69.89	99.83	103.48
Rad β = .78495	71.96	97.79	100.96

Figure 9 is a plot of hex records 26 (reference 68308) and 29 (lot U), for both unsmooth and smooth data. The smooth data is slightly shifted at the steep slope. Figure 10 is a closed bomb plot of these records when the data is smoothed and differentiated according to the RC method. In Figure 11, for comparison, the unsmoothed data for both records was smoothed and differentiated by a nine point cubic polynomial least squares fit, and note the essential differences:

1. Magnitude of the derivative is much smaller, and is now the actual physical derivative of the pressure.
2. The peak is shifted to a lower pressure.
3. Finer detail is seen in the early ignition phase.
4. The infinite slope near peak pressure acquires a finite negative value.

Although the RC method here produces a smoother curve, it conceals features of the pressure trace available from the original signal.

A.4 Methods of Calculating RQ:

MIL-STD-286B (30 June 1971) Method 801.1 directs closed bomb data be plotted as dp/dt vs p by a suitable system. Each axis is scaled to 2 volts. The pressure axis is arranged so the maximum pressure value lies between 1.75 and 2 volts. The four points on the dp/dt axis intersecting the 0.5, 0.75, 1 and 1.25 volt p values are the four data points per firing. The method directs that for several test propellant (or for reference propellant) firings, the dp/dt values for all the test propellant firings be averaged at each of the four reference pressures. The same is done for the reference propellant firings. The averages of the test are then divided by the corresponding averages of the reference to obtain four ratios. These four ratios are then averaged to obtain the RQ. There is no mention of reporting standard deviation or range. Mathematically:

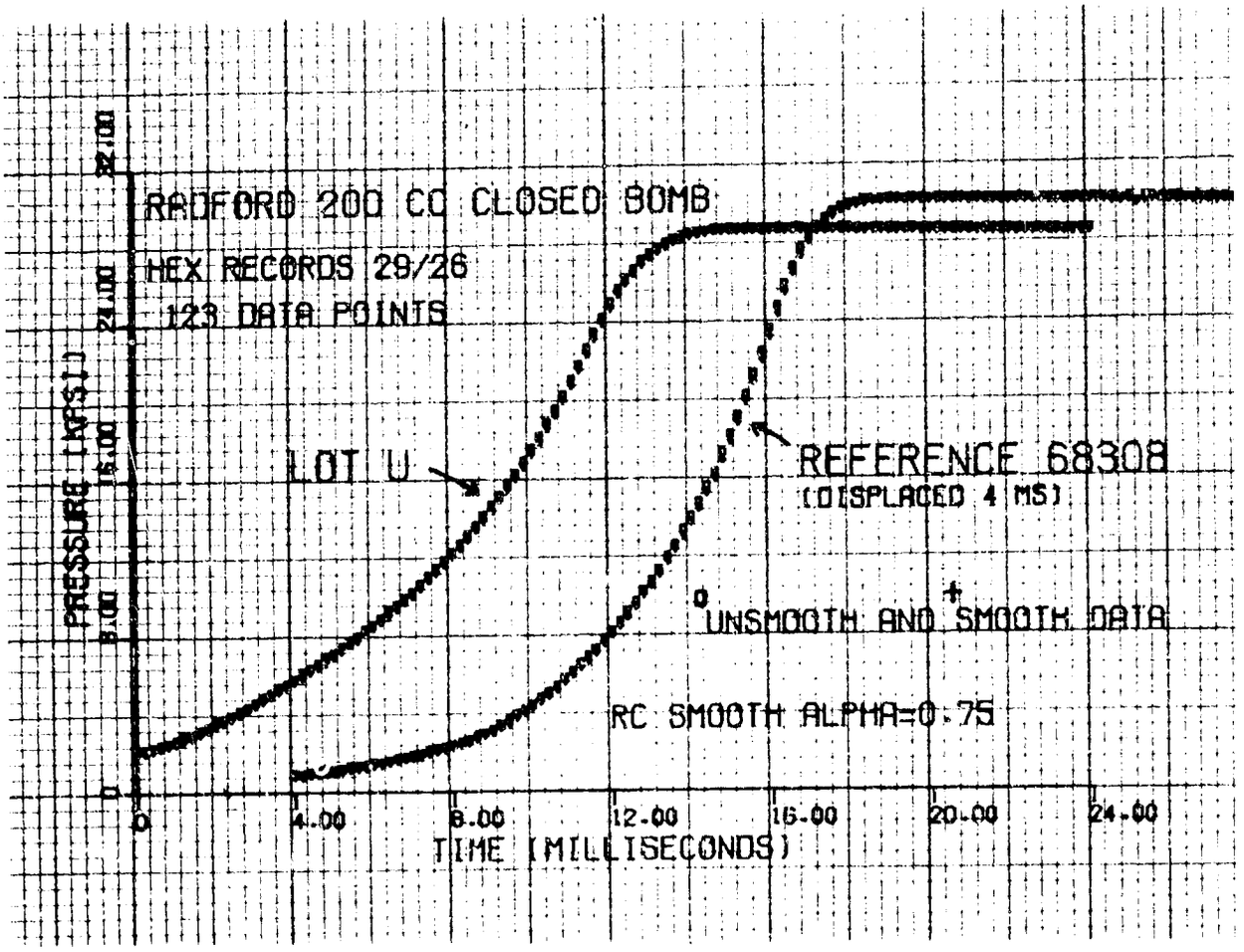


Figure 9 Pressure-time Plot for Unsmooth, Smooth Data

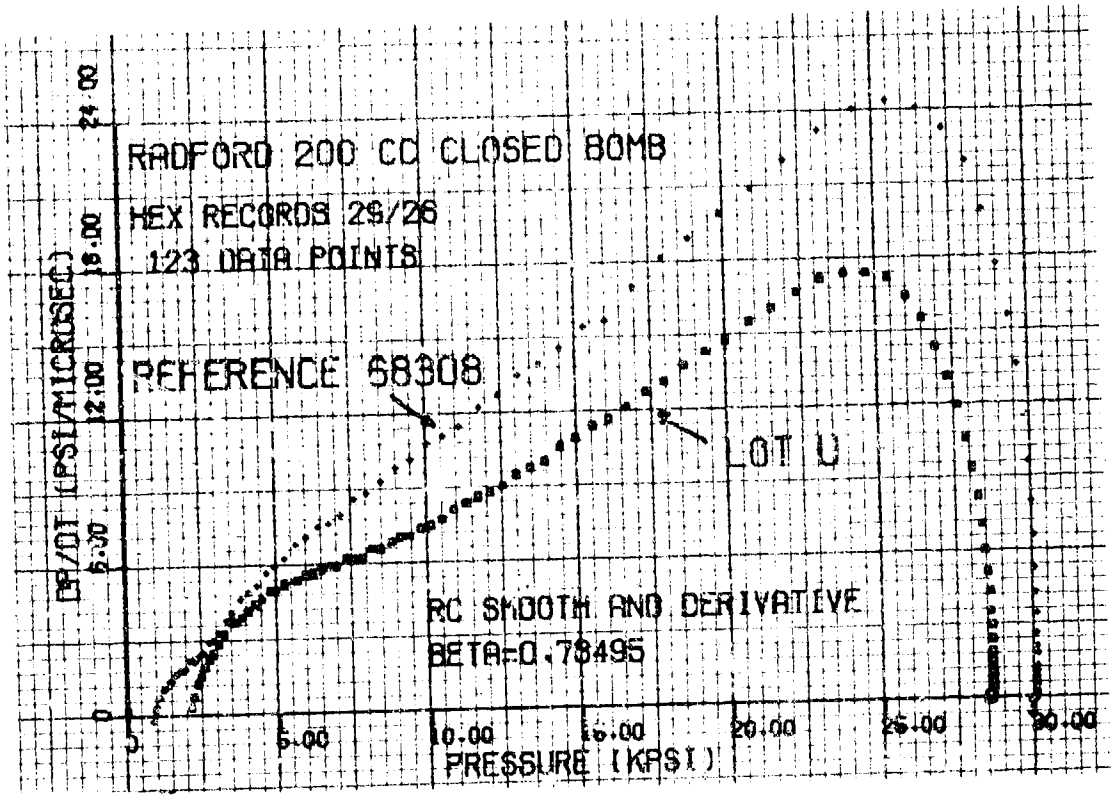


Figure 10 Closed Bomb Plot -RC Analysis

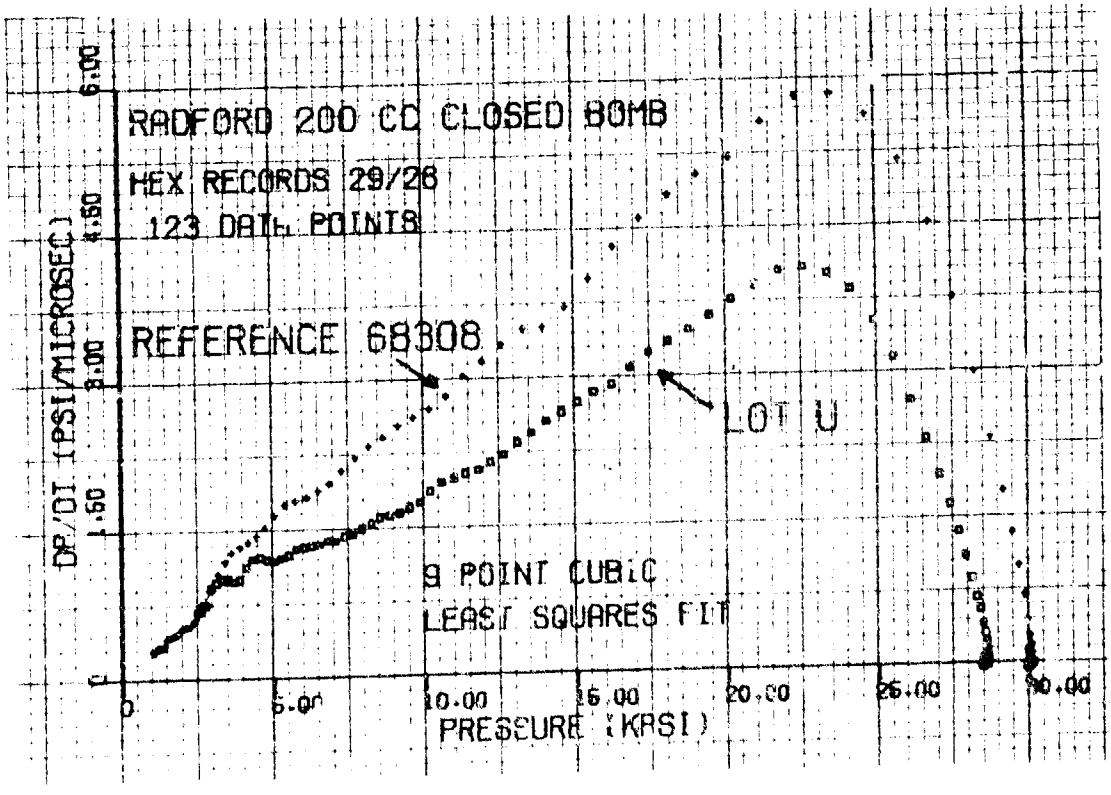


Figure 11 Closed Bomb Plot-Least Squares Fit

$$RQ_{MIL} = \frac{100}{N} \sum_{j=1}^{N} \left(\frac{\sum_{i=1}^{M} T_{ij}}{\sum_{i=1}^{M} R_{ij}} \right) \qquad RF_{MIL} = 100 \left(\frac{\sum_{i=1}^{M} T_{PMAX\ i}}{\sum_{i=1}^{M} R_{PMAX\ i}} \right)$$

M = number of reference firings or test firings (one to seven)
N = number of data points per firings (four)
T_{ij}, R_{ij}, = dp/dt test (reference) propellant value of ith firing and jth data point.
$T_{pmax\ i}$, $R_{pmax\ i}$, = test (reference) propellant maximum pressure for ith firing.

In Radford's method of RQ calculation, intermediate RQ's are determined by immediately averaging the dp/dt ratios for a particular test and its reference firing. Intermediate RQs are averaged for a reported RQ. A standard deviation can be calculated for these intermediate RQs, since each intermediate RQ involves a specific test and reference firing, not a mixture of several. Mathematically:

$$RQ_{RAD} = \frac{1}{M} \sum_{i=1}^{M} \underbrace{\left(\frac{100}{N} \sum_{j=1}^{N} \frac{Tij}{Rij} \right)}_{\text{INTERMEDIATE RQ}} \qquad RF_{RAD} = \frac{100}{M} \sum_{i=1}^{M} \left(\frac{T_{PMAX\ i}}{R_{PMAX\ i}} \right)$$

The two methods, MIL and RAD for RQ are not equivalent; but, practically speaking, for the range of data obtained in the closed bomb, and for a wide range of RQ, the difference between the two methods is usually only a few thousands of a percent of RQ.

As an example, closed bomb data from Picatinny Arsenal (192 cm^3, 0.2 g/cm^3) for AUTOCAP lots K, P, Q, R, S, T, U, V, W were used. Reference lot 68308 was not available, and lot K, similar to regular production, was used. Three firings of K were vied with three firings each of lots J and L; three more of K (K1) with lots R, S, V, W; and three more of K (K2) with lots P, Q, T, U. Four data points were used from each firing at the 8, 12, 16, 20 kpsi calibration pressures (linear interpolation needed). The data was processed both by the MIL and RAD method and some results appear in Table 9.

Table 9 MIL and RAD Method of RQ Calculation [a]

Lot	RQ	Lot	RQ
J	99.3607	W	97.5464
	99.3717 (2.00)		97.5462 (0.64)
L	101.7370	P	86.4497
	101.7510 (1.98)		86.4501 (0.35)
R	118.4893	Q	75.1841
	118.4893 (0.84)		75.1870 (0.87)
S	105.4841	T	81.4871
	105.4835 (0.33)		81.4866 (0.50)
V	114.9013	U	66.6622
	114.9016 (0.35)		66.6636 (0.43)

[a]Reference is AUTOCAP lot K. First entry is MIL calculation; second entry is RAD calculation with standard deviation of the three intermediate RQs by the RAD method.

Sources of variation in RQ are shown if the mean and standard deviation of dp/dt are calculated at each calibration pressure. This is done in Table 10 for Picatinny firings, though only for a sample of 3 firings per lot.

Table 10 Mean and SD of DP/DT (psi/μ s) at Calibration Pressures.

		0.5 volt 8 kpsi	0.75 volt 12 kpsi	1.0 volt 16 kpsi	1.25 volt 20 kpsi
(Ref)	K $\bar{x}$	2.0116	3.0253	4.1442	5.3613
	σ	.038	.008	.047	.061
	J	2.0113	3.0392	4.0626	5.3613
		.003	.105	.027	.023
	L	2.1093	3.0854	4.1249	5.3919
		.040	.043	.089	.135
(Ref)	K1	2.1962	3.1993	4.3370	5.439
		.013	.023	.022	.021
	R	2.6550	3.8398	5.0523	6.3396
		.023	.040	.035	.081
	S	2.4354	3.4206	4.5010	5.4581
		.019	.042	.053	.047
	V	2.6659	3.6876	4.8327	6.0662
		.034	.018	.033	.048
	W	2.3056	3.0902	4.0776	5.1453
		.021	.037	.033	.057

B. Picatinny Arsenal

B.1 Hardware

A variety of closed bombs are available with the 194 cm^3 used primarily. The ignitor consists of one gram of class 5 black powder tissue-wrapped around an M100 Atlas Match (electric squib) positioned at the top of the propellant bed. The pressure transducers are Kistler models: 607B, 607C4 (100 kpsi), and 701H for low pressure. The higher pressure models have about 1/8" recess from the wall. The gage is recalibrated absolutely with accuracy to 0.5% each working day by a dead weight method. Oil pressure is increased gradually from zero to 40 kpsi over a period of about 20 seconds. For the present instrumentation, the method is:

Static KPSI	Sensitivity Range (psi/v)		Volt	Pcb
20	5.00	200	4.030	4030
30	5.00	200	6.142	6142
40	5.00	200	8.172	8172

The best fit equation becomes: Pcb = 0.2107 psi - 182. Then 25x0.2107 = 5.27=new sensitivity setting for the charge amplifier. (Range x 250 = psi/v).

The general schematic of operation is illustrated in Figure 12.

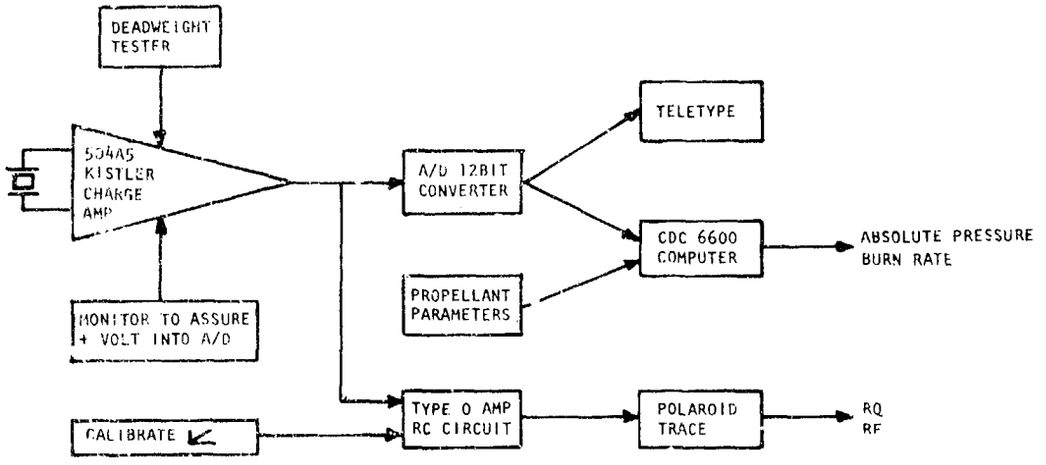
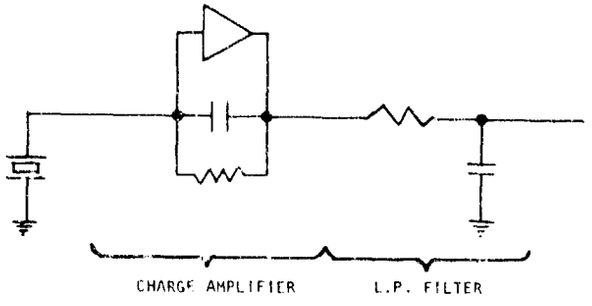
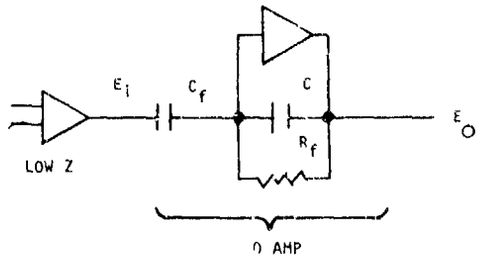


Figure 12 Picatinny Closed Bomb Instrumentation

The charge amplifier offers essentially zero impedance to the high impedance pressure gage. The current generated is allowed to flow and is continuously stored in the feedback capacitor across the amplifier. Negligible capacitative effect results and practically no voltage buildup occurs on the gage cable. (The Radford RC system follows a pattern of a charge amplifier).



The type 0 Textronix amplifier is a high pass filter and is calibrated by a ramp pulse. It performs differentiation of the pressure and for a particular M30 propellant, typical circuit values were:



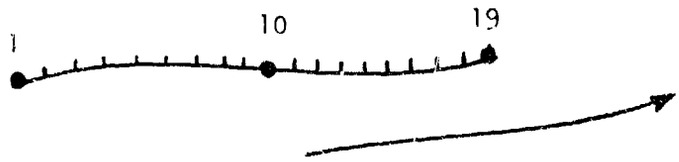
$C_f = 0.1\ \mu f$
$R_f = 200\ k\Omega$
$C = 0.00082\ \mu f \simeq C_f/100$
(low pass filter capacitor for noise suppression).

$$E_o = -R_f\ C_f\ dE_i/dt$$

A 12 bit converter with a small computer is used with a teletype. The sample time is 32 microseconds, or its multiples. Data is transmitted to the central computer for computing (1) the absolute pressure and dp/dt by a method to be described; and (2) the burn rate $r = bP^n$ by the model of Wallace and Pallington (References 3, 4) as a function of pressure, and for any range of pressure. RQ and RF are determined only from polaroid traces using the Type O plug in.

B.2 Numerical Methods

The method used to both smooth and differentiate digitized data is by a moving 19 point cubic least squares fit (Reference 12). Table 11 lists convolution constants for implementing various point fits. At any interval, 19 consecutive points are involved:



As shown in the sketch, point number 10 is smoothed to a new value by its 18 neighboring points; and its derivative is calculated immediately. The iteration proceeds to points from 2 to 20, and the calculation is repeated.

A set of points can be smoothed by incorporating a convolution function. For a constant function, a moving average occurs where the convolutes multiply each data point by one, and the normalizing factor is the number of interval points. An exponential function can simulate an RC time constant where the current point has greatest weight, with previous points weighted by exponential decay. This simulates an RC filter where past but not future points are considered. When a complete set of points is available, smoothing and differentiating can be done by looking both backward and forward from any digitized point. One-sided RC or ramp functions do not have this characteristic. A least-squares procedure leads to a set of convolutes or weighting constants for data points in an interval, and has past-future aspects. The interval should have the number of points small enough so no more than one inflection is included. This method

applies to equally spaced abscissa points. This method for smoothing and differentiating is easily implemented in a computer program as illustrated by a Fortran routine for an L point fit for a set of ninety data points P(90).

Table 11 LEAST SQUARES CONVOLUTES

Smoothing and Derivative Coefficients for Constant Time Interval Data.

Point Interval	Coefficients	Normalizing Factor
5 S	-3, 12, 17, 12, -3	35
DQ	-2, -1, 0, 1, 2	10
DC	1, -8, 0, 8, -1	12
2D	2, -1, -2, -1, 2	7
7 S	-2, 3, 6, 7, 6, 3, -2	21
DQ	-3, -2, -1, 0, 1, 2, 3	28
DC	22, -67, -58, 0, 58, 67, -22	252
2D	5, 0, -3, -4, -3, 0, 5	42
9 S	-21, 14, 39, 54, 59, 54, 39, 14, -21	231
DQ	-4, -3, -2, -1, 0, 1, 2, 3, 4	60
DC	86, -142, -193, -126, 0, 126, 193, 142, -86	1188
2D	28, 7, -8, -17, -20, -17, -8, 7, 28	462
11 S	-36, 9, 44, 69, 84, 89, 84, 69, 44, 9, -36	429
DQ	-5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5	110
DC	300, -294, -532, -503, -296, 0, 296, 503, 532, 294, -300	5148
2D	15, 6, -1, -6, -9, -10, -9, -6, -1, 6, 15	429
13 S	-11, 0, 9, 16, 21, 24, 25, 24, 21, 16, 9, 0, -11	143
DQ	-6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6	182
DC	1133, -660, -1578, -1796, -1489, -832, 0, 832, 1489, 1796, 1578, 660, -1133	24024
2D	22, 11, 2, -5, -10, -13, -14, -13, -10, -5, 2, 11, 22	1001
15 S	-78, -13, 42, 87, 122, 147, 162, 167, 162, 147, 122, 87, 42, -13, -78	1105
DQ	-7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7	280
DC	12922, -4121, -14150, -18334, -17842, -13843, -7506, 0, 7506, 13843, 17842, 18334, 14150, 4121, -12922	334152
2D	91, 52, 19, -8, -29, -48, -53, -56, -53, -48, -29, -8, 19, 52, 91	6188

17	S	-21, -6, 7, 18, 27, 34, 39, 42, 43, 42, 39, 34, 27, 18, 7, -6, -21	323
	DQ	-8, -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8	408
	DC	748, -98, -643, -930, -1002, -902, -673, -358, 0, 358, 673, 902, 1002, 930, 643, 98, -748	23256
	2D	40, 25, 12, 1, -8, -15, -20, -23, -24, -23, -20, -15, -8, 1, 12, 25, 40	3876
19	S	-136, -51, 24, 89, 144, 189, 224, 249, 264, 269, 264, 249, 224, 189, 144, 89, 24, -51, -136	2261
	DQ	-9, -8, -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9	570
	DC	6936, 68, -4648, -7481, -8700, -8574, -8179, -5363, -2816, 0, 2816, 5363, 8179, 8574, 8700, 7481, 4648, -68, -6936	255816
	2D	51, 34, 19, 6, -5, -14, -21, -26, -29, -30, -29, -26, -21, -14, -5, 6, 19, 34, 51	6783
21	S	-171, -76, 9, 84, 149, 204, 249, 284, 309, 324, 329, 324, 309, 284, 249, 204, 149, 84, 9, -76, -171	3059
	DQ	-10, -9, -8, -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10	770
	DC	84075, 10032, -43284, -78176, -96947, -101900, -95338, -79564, -56881, -29592, 0, 29592, 56881, 79564, 95338, 101900, 96947, 78176, 43284, -10032, -84075	3634092
	2D	190, 133, 82, 37, -2, -35, -62, -83, -98, -107, -110, -107, -98, -83, -62, -35, -2, 37, 82, 133, 190	33649

S -- Smoothing Coefficients for quadratic and cubic fit.
DQ -- First derivative coefficients for quadratic fit.
DC -- First derivative coefficients for cubic fit.
2D -- Second derivative coefficients for quadratic and cubic fit.

A sample calculation is shown for obtaining the smooth pressure value and its first derivative for the midpoint of a 7 point fit:

$$\overline{P_4} = (-2\,P_1 + 3\,P_2 + 6\,P_3 + 7\,P_4 + 6\,P_5 + 3\,P_6 - 2\,P_7)/(21.)$$

$$dP_4/dt = (22\,P_1 - 67\,P_2 - 58\,P_3 + 58\,P_5 + 67\,P_6 - 22\,P_7)/(252.\Delta T)$$

```
          DO    10  M = L, 90
          AS =   0.
          AD =   0.
          DO    20  N = 1, L
          K = M + N - L
          AS = AS + P(K)*SC9(N)
 20       AD = AD + P(K)*DC9(N)
          S (M - (L/2)) = AS/NSC9
 10       D (M - (L/2)) = AD/(NDC9*DT)
```

where L = number of points in interval, e.g. 19
SC9 = set of smoothing convolutes
DC9 = set of first derivative convolutes
NSC9 = smoothing normalization
NDC9 = derivative normalization
S, D = smoothed, differentiated points
DT = time sample interval

Some of the various outputs available are illustrated in three Calcomp plots for a lot K firing:

Figure 13: Pressure-time trace. (0.096 ms sample time)
Figure 14: Closed bomb plot by 19 point cubic fit.
Figure 15: Derived burn rate calculation.

It was noted that the A/D converter had a tendency to latch onto decimal values of 127, 191, 255, 319, 383,.... 2239,... (associated binary values have "1" in the last 6 bits) before jumping to a higher value attained by the pressure transducer. This electronic disorder was more noticeable for the fast 32 microsec rate. This latching onto a constant value for several or even two extra data points had a deleterious effect on the numerical method used for the derivative. As an example of what misleading data can do, a record from a fast read rate experimental propellant was processed with a 19 point fit, with a cubic and a quadratic fit, shown in Figure 16. Figure 17 shows the details in the pressure region around 33.8 megapascals (4900 psi). Although the smoothing method tries to compensate for the discontinuity, the derivative fluctuates wildly over this transition. If the quadratic fit rather than the cubic is used, the same oscillation is present but is less pronounced.

One data available from the closed bomb, since it is not vented immediately after peak pressure, is the pressure decay after peak pressure. Available data for two firings (192 cm^3 bomb; 70°F, 0.096 millisecond read rate, 0.2 g/cm^3) gave the following exponential fit for 17 ms of data available after peak pressure:

Lot	
Q	P(kpsi) = 30.86 exp (-1.9317 t(sec))
	Corr. Coef = .99937
K	P(kpsi) = 30.97 exp (-1.202 t(sec))

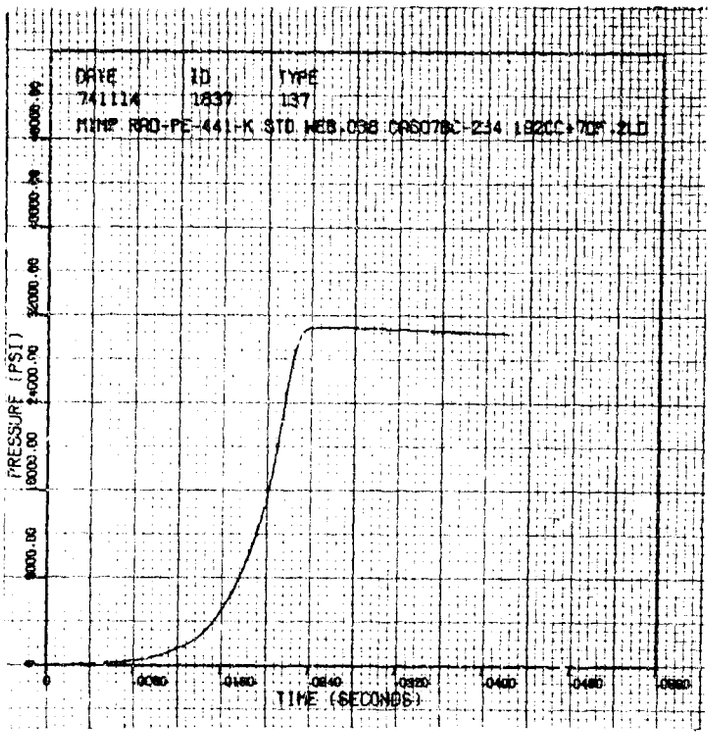


Figure 13 P-T Trace of Lot K

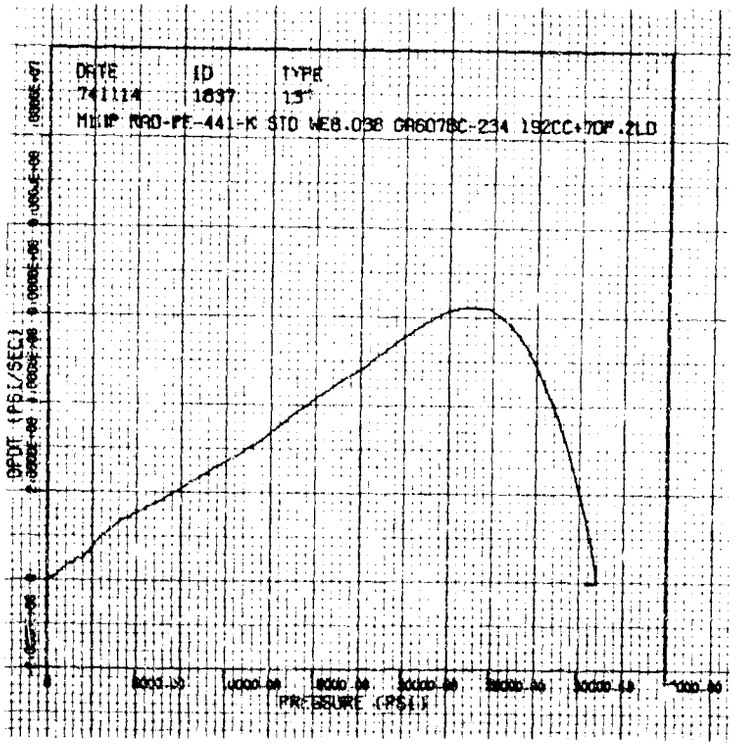


Figure 14 Closed Bomb Plot of Lot K

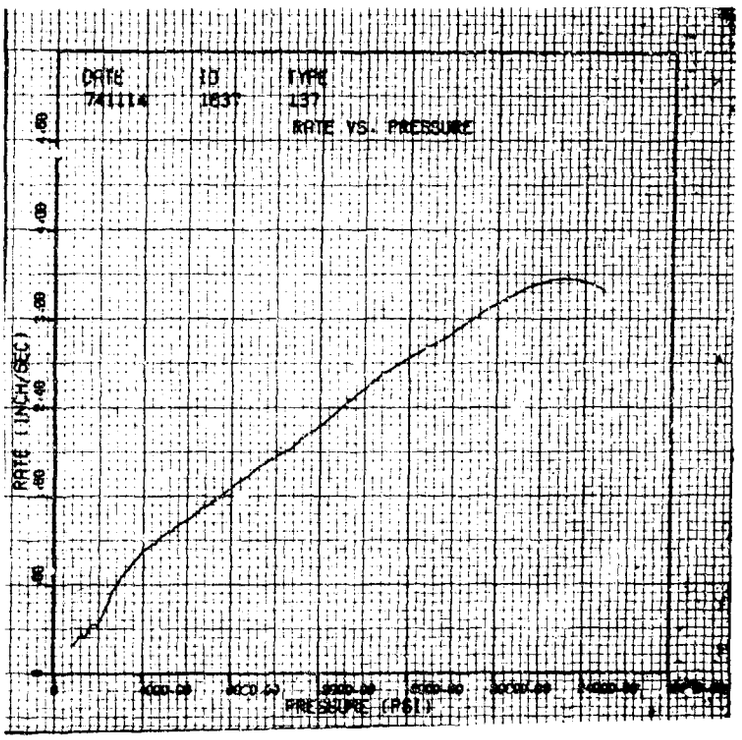


Figure 15 Burn Rate Plot for Lot K

To process IN sets of data of 90 points each, such that the derivative is taken of the smooth pressure data, the following routine can be used: (See note on page 165)

```
            L2 = L/2    $    K1 = L2 + 1    $    K2 = 90 -L2
            DO 30 I = 1,IN
            DO 30 NUM = 1,2
(Routine on page 34 with P(I,K) substituted for P(K))
            DO  3 K = K1, K2
            IF(NUM.EQ.2) GO TO 2
            P(I,K) = S(K)
          2 CONTINUE
          3 DP(I,K) = D(K)
         30 CONTINUE
```

Another definition of RQ not employing derivatives is the ratio of the reference to the test of the time required (Δ T) to span a constant closed bomb pressure range:

$$RQ = \left[\frac{\Delta \text{ T(reference)}}{\Delta \text{ T(test)}} \right] \text{ constant pressure interval.}$$

When this method was employed for the Radford closed bomb firings of the J-W AUTOCAP propellants for the pressure range of 5 to 25 kpsi (or 5 to 20 kpsi), the correlation to ballistics yielded correlation coefficients similar to those in Table 31 (though of negative value). This definition is not equivalent to MIL STD RQ.

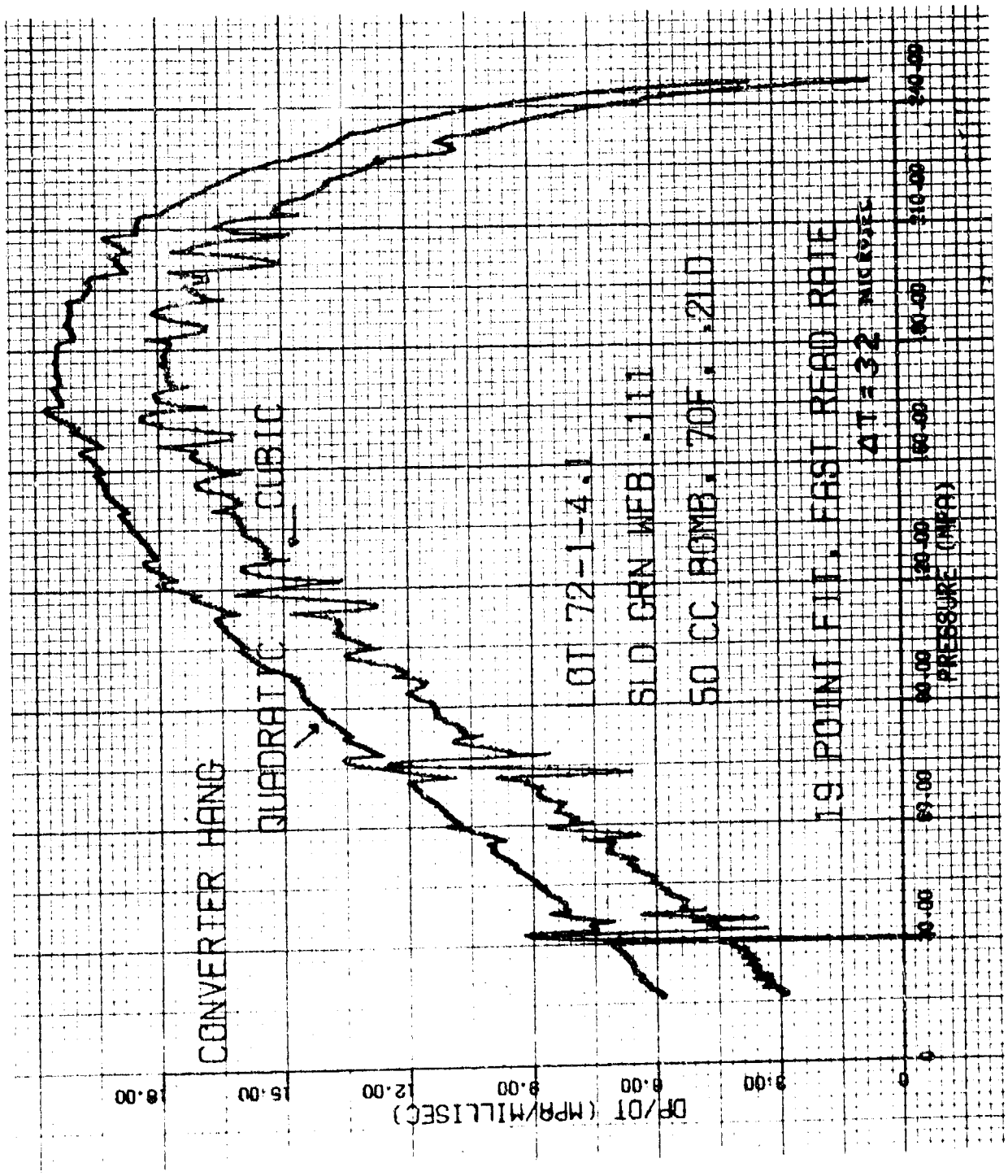


Figure 16 Converter Hang at Fast Read Rate

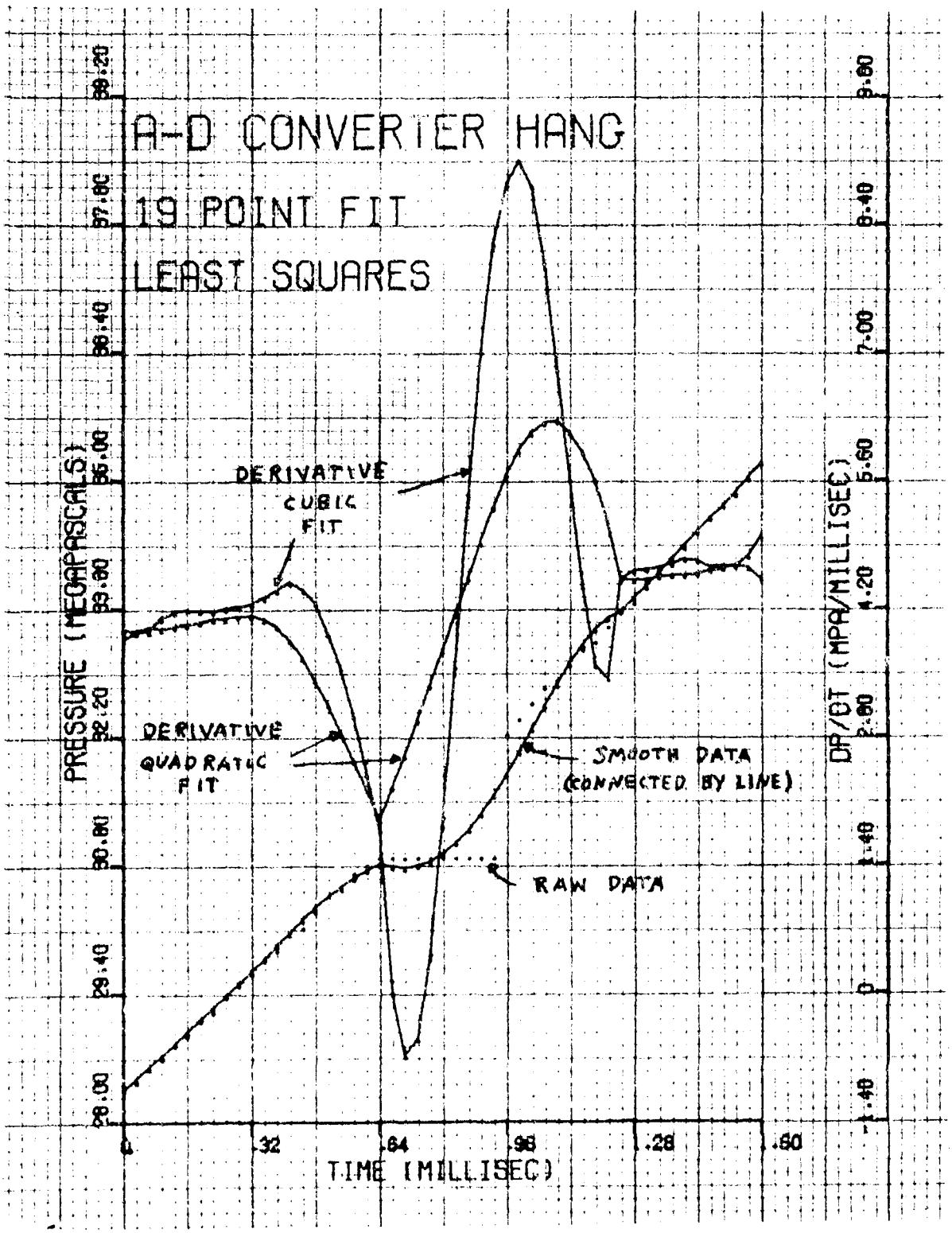


Figure 17 Converter Hang Detail

C. BADGER AAP:

RQ is obtained from both polaroid trace and computerized closed bomb. Ignition is accomplished by 0.1 gram nitrocotton in a loop of a 6 inch piece of #26 nichrome wire at 24 volts. One gram of suitable smokeless ignitor (or blankfire) is used in the 200 cm^3 bomb, with 5 in the 700 cm^3. (References 13, 14, 15). Loading density is 0.2 gram/cm^3 $\pm$ 0.001 g/cm^3.

The loop is attached to the firing head. About half the ignitor is concentrated near the handle end of the scoop with the rest evenly spread down the scoop length. After propellant is poured evenly along the scoop, the scoop is inserted into the bomb until it touches the rear wall. The scoop is rotated slowly 180 degrees, and removed while being pressed to the top of the bomb. Loading is done within two minutes of removal from the oven. The operating system is illustrated in Figure 18.

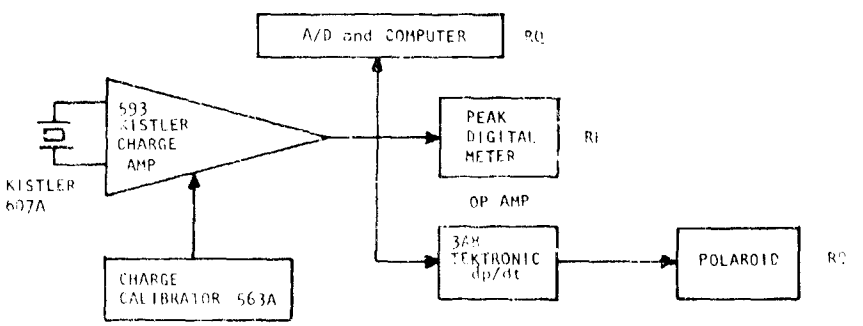


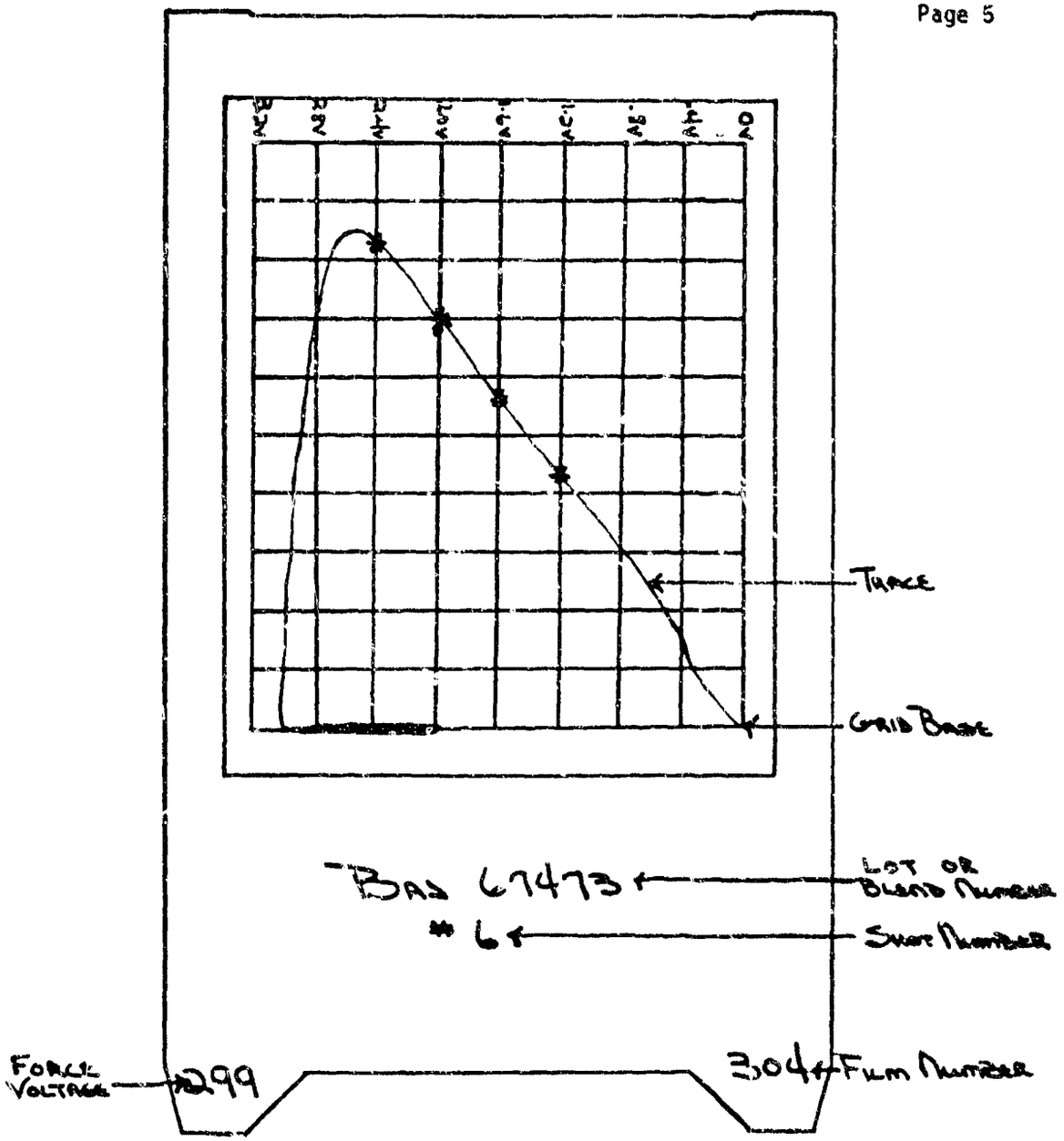
Figure 18 Badger Closed Bomb Instrumentation

A Kistler 607A gage is used with a 593 charge amplifier. Amplifier calibration is done with a 563A charge calibrator. The peak digital meter provides peak pressure for RF. A Heise gage is employed for calibration and voltage is recorded at 5000 lb intervals from 0 to 35,000 psi. A Tektronix 3A8 op amplifier differentiates the pressure for RQ measurement by polaroid trace. A typical polaroid trace is shown in Figure 19.

Analyzing and reporting closed bomb data:

Three shots of the test are fired against three shots of the reference (or standard), and the test series is repeated. If the RQ range of either test series exceeds 3%, that series is void. Additional tests are fired, until two test series are completed, each with an RQ range of 3% or less. RQ and RF for test propellant is determined by the average of these two series. If, however, the averages of the two series vary from each other by more

FILM SAMPLE



* VOLTAGE MEASUREMENT POINTS FOR RQ
1.2V – 1.6V – 2.0V – 2.4V

Figure 19 Badger Closed Bomb Polaroid

than 2%, a third series is fired and RQ and RF reported is the average of all three.

RQ for each test-reference combination is found by dividing the test dp/dt by the reference dp/dt at each or four voltage points and averaging the ratios. The final RQ for each test series is the average of the three RQs. RQ range is the difference between the lowest and highest RQ of the three shots within the test.

Table 12 lists a closed bomb calculation sheet for a polaroid trace RQ and RF measurement. A Honeywell computer employs assembly language. The program does not smooth the entire curve; rather, the program finds the peak pressure and the dp/dt values at four pressure points: 10, 14, 18 and 22 kpsi. (However, if the propellant is designated as "5-inch", the readings are at 8, 12, 16, and 20 kpsi). A particular dp/dt is found by finding a pressure reading just above a reference reading, and by using seven point first derivative convolutes. The derivative is found at this pressure reading:

$$(dp/dt)_0 = (-3\ P_{-3} - 2\ P_{-2} - P_{-1} + P_1 + 2\ P_2 + 3\ P_3)/(28.\Delta T)$$

Then the derivative is found by the same procedure for the point just before the reference pressure. Finally, linear interpolation of the two derivatives is used to find dp/dt at the reference pressure.

A method has been proposed to obtain new expressions for RQ and RF by calculating the second derivative of the pressure-time to gain information on the burn rate. On a dp^2/dt^2 vs t plot, the negative deflection at the end of the graph corresponds to RQ in some manner. The horizontal and vertical deflection of the final point on the curve give values for pressure and a quantity relating to RQ. No further development of this approach seems reported.

An attempt was made to test M6 propellant for the 175mm gun in the 2400 cm^3 rather than in the 700 bomb in which a 0.2 g/cm^3 loading density has only about 39 individual grains. However, a larger grain sample in the 2400 bomb resulted in larger variations, probably due to geometrically locating the propellant and CBI ignition charge. Longer cooling time was also required with the larger bomb.

D. INDIANA AAP

The closed bomb was computerized in 1969. The 200 and 700 cm^3 bombs are used, with the 200 used principally for black powder study (References 16, 17). Ignition uses 0.1 gram guncotton. For lower pressure firings (in-process samples), a Kistler 603A gage is used (3000 psi range) with ten grams of

Table 12 Badger RQ Calculation Sheet

Figure 2

703-Standing Operating Procedures
for Analyzing and Reporting
Closed Bomb Data
Revision 2
1 June 1970
Page 6

B-546 Rev. I

CLOSED BOMB CALCULATION SHEET

Type Powder 8" MP
Lot or Blend No. BAD 65/91
Reference Powder Lot No. BAL 63625
Temperature 90°F.

Date 3-20-70
Bomb Size 200 CC
Charge Weight 38.560
Pressure Transducer No. 1096

Test No. 1 Shot No. 1

Powder Type	Film No.	1.2V	1.6V	2.0V	2.4V	Force V	
Standard	875	544	690	844	992	306	R.F. 99.35 %
Test Powder	876	520	656	803	945	304	Ave. R.Q. 95.27 %
R.Q. at each	Voltage Step	95.59	95.07	95.14	95.26		

Test No. 1 Shot No. 2

Powder Type	Film No.	1.2V	1.6V	2.0V	2.4V	Force V	
Standard	879	540	686	835	984	305	R.F. 99.34 %
Test Powder	880	510	648	797	940	303	Ave. R.Q. 94.97 %
R.Q. at each	Voltage Step	94.44	94.46	95.45	95.53		

Test No. 1 Shot No. 3

Powder Type	Film No.	1.2V	1.6V	2.0V	2.4V	Force V	
Standard	884	541	693	846	995	305	R.F. 99.34 %
Test Powder	885	519	658	808	953	303	Ave. R.Q. 95.54 %
R.Q. at each	Voltage Step	95.93	94.95	95.51	95.78		

Test No. 2 Shot No. 4

Powder Type	Film No.	1.2V	1.6V	2.0V	2.4V	Force V	
Standard	889	541	690	843	993	305	R.F. 99.34 %
Test Powder	890	513	653	804	953	303	Ave. R.Q. 95.20 %
R.Q. at each	Voltage Step	94.83	94.64	95.37	95.97		

Test No. 2 Shot No. 5

Powder Type	Film No.	1.2V	1.6V	2.0V	2.4V	Force V	
Standard	891	540	690	843	993	305	R.F. 99.67 %
Test Powder	892	509	651	805	953	304	Ave. R.Q. 94.84 %
R.Q. at each	Voltage Step	93.57	94.35	95.49	95.97		

Test No. 2 Shot No. 6

Powder Type	Film No.	1.2V	1.6V	2.0V	2.4V	ForceV	
Standard	893	548	693	844	991	305	R.F. 99.67 %
Test Powder	894	514	655	809	955	304	Ave. R.Q. 95.19 %
R.Q. at each	Voltage Step	93.80	94.52	95.85	96.37		

Average R.Q. for all shots	95.26 %	95.06 %	Avg. R.Q. between Tests	95.16 %
Average R.F. for all shots	99.34 %	99.56 %	Avg. R.F. Between Tests	99.45 %
Range of R.Q.	.57 %	.36 %	R.Q. Range Between Tests	.20 %
Range of R.F.	.01 %	.33 %	R.F. Range Between Tests	.22 %

Computer JW
Checked By VH
Supervisor MR

black powder (pass through #6 and retain on #7 sieve). For finished grain and green grain, the 607A Kistler (Sunstrand) (70 kpsi range) is used with the usual 0.2 g/cm^3 (40 gram) loading. The general schematic of the system is depicted in Figure 20.

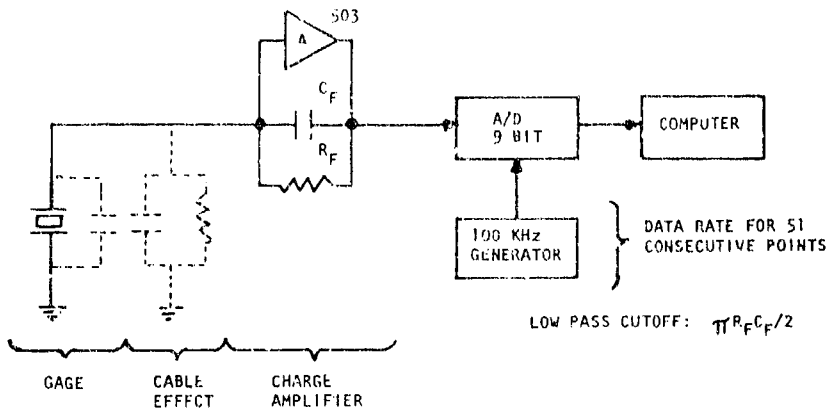


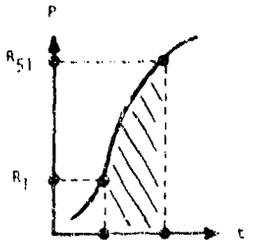
Figure 20 Indiana Closed Bomb Instrumentation

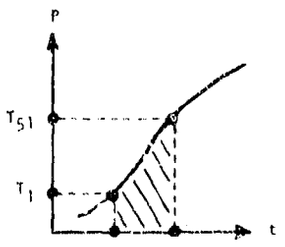
The gage is calibrated hydraulically with a charge amplifier, as in a system operation.

A HP-2114A computer with a nine bit (10 including sign) A/D converter is used with a sample time of 0.1 ms. The highest converter output is 511 (2^9-1). The program accepts a predetermined firing sequence of three groups, each consisting of a reference and three test firings.

Determination of RQ:

A unique method is used for RQ which is equivalent to a trapezoidal integration of the linear portion of the pressure-time trace. This is physically equivalent to an impulse calculation. The low pressure region is monitored until the pressure rise is fairly linear. After 10 kpsi threshold, the next 51 pressure readings are cumulatively added at 0.1 ms intervals. This procedure is repeated for the same time interval for the test propellant. RQ is taken as the ratio of these areas; RF is the quotient of the highest converter output. No derivatives are calculated.





$$RQ \equiv \frac{\sum_{i=1}^{51} T_i}{\sum_{i=1}^{51} R_i}$$

A suggestion was made to use an internal standard determined by a history of reference firings.

Table 13 lists raw converter output for a firing of DuPont black powder. Figure 21 is a plot of this data. If this is used as a reference, and compared with a firing of Olin 689 Jet Mill black powder moisture 0.09% (12-14, 71), starting from about the same pressure level, the 51 points are summed from 130 to 374 for the DuPont data, and from 132 to 340 for the Olin data. The RQ and RF become:

RQ = 12391/14150 = 87.6% RF = 395/397 = 99.5%

The exponential decay curve after peak pressure for this data has the form:

$$P(kpsi) = 7.05 \exp(-2.318\ t(sec)) \quad \text{for } 0 < t < .065$$

with a correlation coefficient of 0.998 for this 65 ms interval.

Table 13 Closed Bomb Black Powder Data

A-D Converter Pressure Closed Bomb for DuPont 111-12 (F/P) Black Powder, Standard Moisture 0.26% (11-12-71) with 0.1 ms sampling.

10	34	88	186	283	346	378	392	396	396
11	36	94	193	288	349	380	392	396	396
12	39	99	200	293	352	381	393	396	396
13	41	105	207	298	355	382	393	396	396
14	44	111	214	303	357	383	394	396	396
15	47	117	221	308	360	384	394	397	396
17	51	123	227	312	362	385	394	397	396
18	54	130	234	317	364	386	395	396	396
20	58	137	241	321	366	387	395	396	396
22	61	143	247	325	368	388	395	397	396
23	65	150	253	329	370	389	395	396	396
25	70	157	259	333	372	390	396	397	396
27	74	164	266	336	374	390	396	396	395
29	78	171	271	340	375	391	396	396	395
31	83	178	277	343	377	391	396	396	395

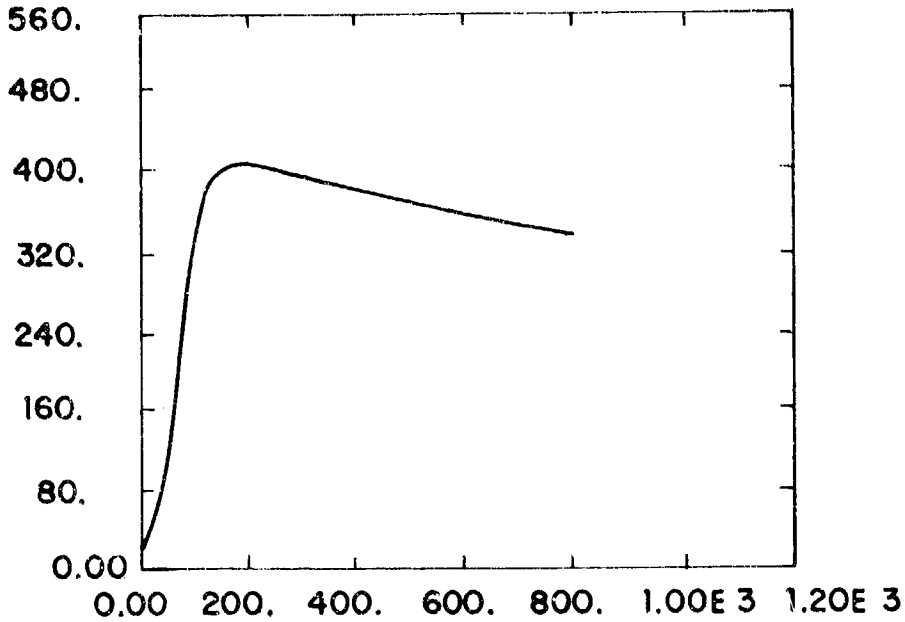


Figure 21 Closed Bomb Blackpowder P-T Plot
(DuPont 111-12 Finished Black Powder,
Standard Moisture 0.26% 11-12-71.
Converter output vs number of data points.)

(Loading = 0.13 g/cc)

E. BALLISTIC RESEARCH LABORATORY

An 89 cm^3 impulse closed bomb (Model 601, Technoproducts) is currently in use, and 200, 500, and 700 cm^3 bombs are planned for acquisition. An M52A3 electric primer is used directly over the propellant for small arms powder. Other ignitors are planned for the larger bombs. The overall schematic is pictured in Figure 22.

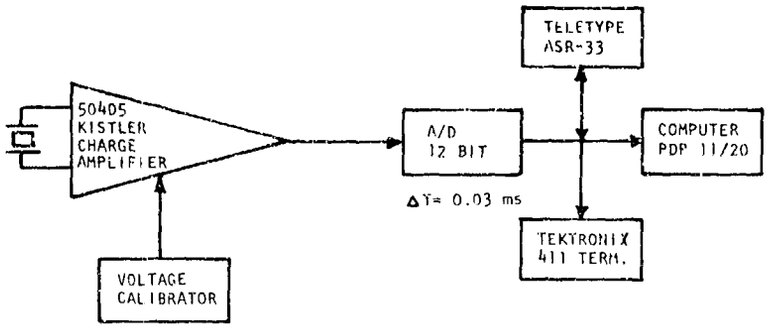


Figure 22 BRL Closed Bomb Instrumentation

A 504A Kistler (Sunstrand) charge amplifier is used with a plug-in filter. A 20 kpsi peak pressure is generally reached with a 0.15 g/cm^3 loading density. The digitized data is stored on tape. Sampling is done each 30 microseconds with about 1000 points taken. Efforts are being expended to consolidate both data acquisition and reduction programs on the PDP 11/20 by using machine language for critical time portions and Fortran IV for other program portions.

Data reduction differs according to using branches:

1) Dynamics: dp/dt is calculated by eleven point quadratic polynomial fit. RQ and RF follow MIL-STD approach. Burning rate calculations are also made.

2) Applied Ballistics: Pressure is smoothed and differentiated by fitting a cubic polynomial by a least squares fit: $P = a + bt + ct^2 + dt^3$. Another method is used for calculating burning rate.

F. NAVAL ORDNANCE STATION (Indian Head, Md.)

RQ is determined exactly as in MIL-STD-286, Method 801.1, with the 200 and 700 cm^3 bombs. The gages are the four crystal type in Figure 3, and stored in a dissicator at room temperature when not in use. Gages are not calibrated prior to use, as the equipment is not used to measure absolute pressure or rate.

About three inches of open wire from the gage is connected to about 30 feet of coax. The instrument panel is a Unidynamics Model 2B (with oscilloscope, amplifiers, controls, series of capacitors in the pressure rate amplifier to filter the pressure rate data).

Procedure:

Propellant is conditioned for one day at 65 to 70°F. Loading density is 0.2 g/cm^3 with a grain cut, if necessary, to achieve weight to the nearest 0.1 milligram. An ignition squib consists of 0.10 grams of DuPont 700X (granular, smokeless) powder wrapped in tissue with a nichrome wire. The main booster charge consists of 1 gram of the same powder for both bombs. The schematic shown in Figure 23 is similar to Radford AAP:

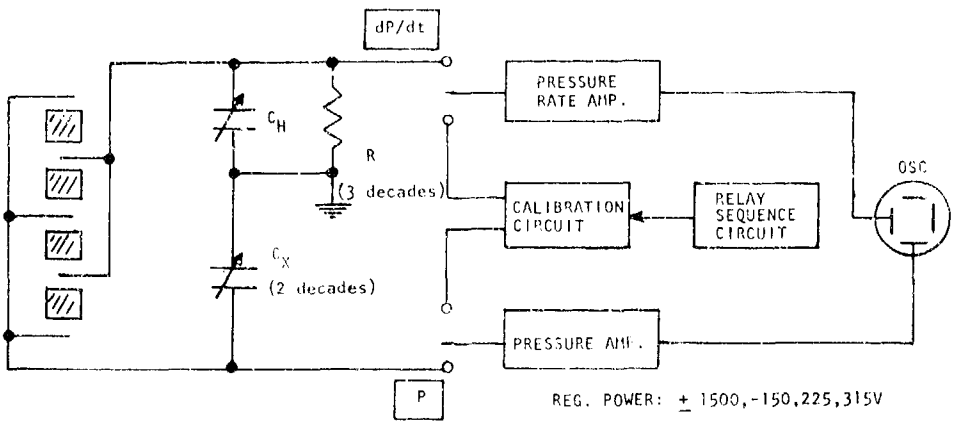


Figure 23 NOS Closed Bomb Instrumentation

Loading procedure:

1. After gage installation, the propellant is placed in a scoop, inserted into the bomb, and pushed with a stick in a pile sloping downward from the gage.

2. One gram of DuPont 700X is placed in the scoop and a trail made over the propellant length. A small pile of the ignitor is made near the ignitor so it will be in contact with the squib when inserted.

3. The firing head is inserted so the squib assembly comes in contact with the ignitor pile.

Operating procedure:

1. After a warmup shot, if a test propellant is to be fired against a reference, one or two shots of each is fired to obtain

proper settings for resistance, capacitance and filtering to assure the oscilloscope trace will occupy about 80 percent of the scale and will be smooth. Initial values of R, C_X and C_H are based on past tests, but are changed if necessary. Same settings are used for the test and reference firings. Table 14 lists RC values for various gun propellants.

Table 14 NOS Closed Bomb RC Circuit Values

Caliber (Formulation)	Bomb (cm^3)	Resistance R (KΩ)	Capacitance C_X (μf)	Hash Capac. C_H (μf)
20MM (SPDN)	200	28	0.078	0.005
40MM (SPDN)	200	165	0.068	0.005
3"/50 (SPCG)	700	90	0.072	0.021
5"/38 (SPD)	700	170	0.064	0.021
5"/54 (M-26)	700	140	0.080	0.021
5"/54 (NACO)	700	170	0.064	0.021
8"/55 (NACO)	700	325	0.065	0.021
8"/55 (NACO) (lightweight gun)	700	225	0.065	0.021

2. Usually three shots are fired (alternating, reference-test). If one shot diverges greatly from the other two, a fourth or fifth is fired. This usually occurs only with experimental propellants.

3. After the fire signal, the calibration grid in 0.25 volt increments is displayed on the oscilloscope by means of a stepping relay. Then the bomb is fired.

4. Polaroids are measured for RQ as in Method 801.1. For RF, rather than using a line through the furthest portion (from the dp/dt axis) of the descending trace, the value is used where the descending trace intersects the 0.5 volt line for dp/dt. This appears to give a more consistent force measurement.

An example RQ, RF calculation is given for M6+2 propellant for the 76mm made by Radford AAP and retested at NAVORDSTA in a 700 cm^3 bomb at 0.2 g/cm^3. Circuit values were: R=170 kΩ, C_X=0.070 μf; C_H=0.021 μf. Propellant properties are listed:

	Reference[a]	Test[b]
NC	87.21	87.69
DNT	9.37	9.21
DBT	3.42	3.10
DPA	1.06	1.03
K2S04	2.00	2.08
TV	1.62	1.66
H20	0.55	0.68
RS	1.07	0.98

	Reference[a]	Test[b]
Length(inch)	0.682	0.680
Diameter	0.289	0.283
Perf dia	0.031	0.032
Inner web	0.049	0.047
Outer web	0.050	0.048

a Lot RAD-E33D
b Lot RAD-E38

Typical oscilloscope traces of these firings are given in Figure 24.

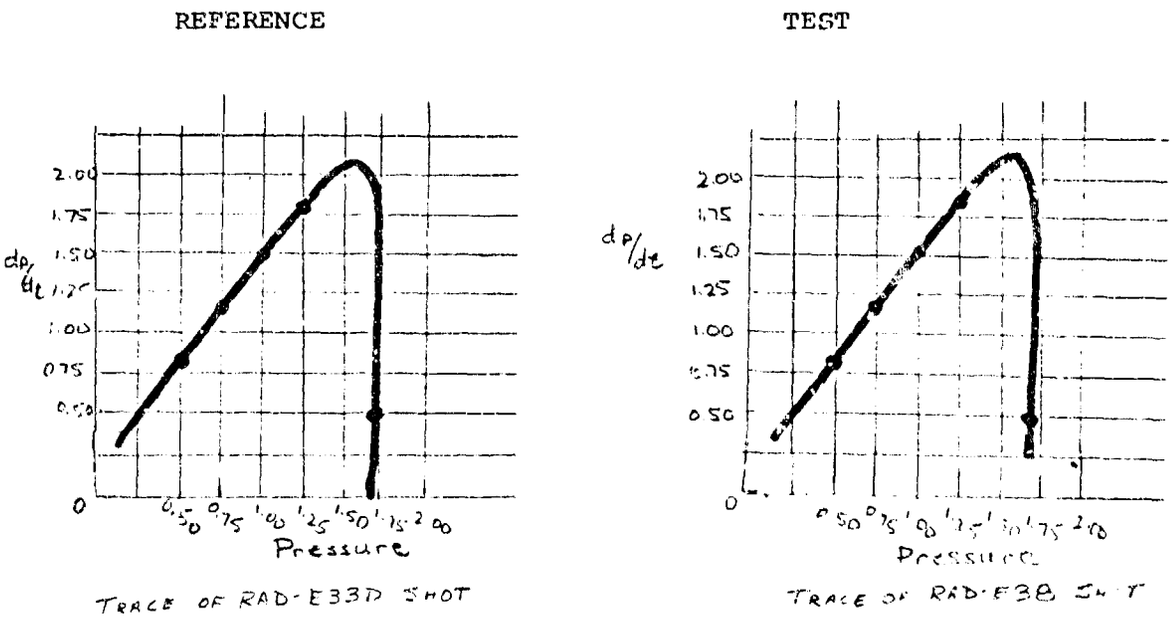


Figure 24 NOS Closed Bomb Plots

Table 15 lists the RQ, RF calculations for the test firing of lot RAD-E38. Also for the sake of illustration, instead of finding the average dp/dt at each pressure voltage reference, the three intermediate RQs and RFs are calculated as done by Radford. Note that the final RQ and RF are almost the same. The Radford method in this case shows a larger range for RQ.

Table 15 RQ, RF Calculations for RAD-E38

Propellant Sequence	REF 1	TEST 2	REF 3	TEST 4	REF 5	TEST 6
dp/dt values at						
0.50 v	0.813	0.875	0.838	0.863	0.325	0.813
0.75 v	1.138	1.188	1.150	1.200	1.163	1.175
1.00 v	1.450	1.525	1.450	1.500	1.475	1.500
1.25 v	1.788	1.875	1.788	1.800	1.800	1.850
Max pressure	1.700	1.713	1.713	1.725	1.738	1.725

Average dp/dt at	Reference	Test
0.50 volts	0.825333	0.850333
0.75	1.150333	1.187667
1.00	1.458333	1.508333
1.25	1.792000	1.841667
Average max pressure:	1.717000	1.721000

MIL STD (NAVORDSTA) Method

RQ at:	
0.50 v	103.0291
0.75 v	103.2455
1.00 v	103.4286
1.25 v	102.7716
RQ	103.1187
RF	100.2330

RADFORD Method

RQ for each firing pair:	RQ	RF
1.	105.5145	100.7647
2.	102.8626	100.7005
3.	101.0125	99.2520
RQ	103.1299	
RF	100.2391	

A computer is not used to calculate RQ. For interior ballisitics calculations, burn rate measurements are derived from closed bomb data by use of the following expression for a specific pressure range, and implies the need for absolute pressure calibration:

$$dx/dt = \frac{V\ dp/dt}{S\ [\rho RT\ (\eta\rho - 1)\ P]} = BP^n$$

η = covolume
ρ = propellant density
T = propellant gas temperature
S = burning surface area

It was reported that best results occurred by fitting a floating polynomial to five selectable neighboring points by a least squares method. If the five points are nearest neighbors, and the sample time is short, fluctuations in the derivative are to be expected.

II. AUTOCAP LOTS J-W Single Base M1 Propellant Firings

A. Autocap Propellant and Ballistic Firings:

To ballisitically determine the effect of out of specification propellant production, seven perforation single base propellant for the M4A2 charge (155mm, M126 howitzer) was manufactured to the following variations: (See Table 16)

LOTS	VARIABLE
J, K, L	Length of grain: J about 0.2" long, and L about 1 inch.
M, N	Six outer perf hole location. Near center for M.
(P,Q,R,S),(T,U,V,W)	Low K2S04; High K2S04
(P,R,T,V),(Q,S,U,W)	Low moisture; High moisture
(R,S,V,W),(P,Q,T,U)	Smaller; larger diameter grain (Same length to diameter ratio).

These 13 lots were fired with four shots each at both zone 5 and 7, together with 2 more lots formed by a 30-70% mixture of J and L, and a 13-28-59% mixture of J, K, and L. Ballistic results are given in Table 17.

The standard deviation for the muzzle velocities (also peak chamber pressure) decreased for the mixture lots of J, K, L for zone 7 (not for zone 5). This occurrence prompted the manufacture of another batch of long grain designated as the LL lot. A mixture of J, K, and LL had 16 firings at zone 7 and 12 at zone 5. The results were disappointing as the velocity standard deviation was high for zone 7, though somewhat lower for zone 5. Some uncertainty remains in the JKLL firings since the three 100 lb propellant cans shipped to APG were not mixed prior to loading, and a question remains on the grain distribution homogeneity in the prop charges.

It should be noted that the mean muzzle velocities of the reference firings for lots J through N, and the JKLL firings were higher than those for the P through W firings; and this might be attributable to the warmer season of the year at firing time:

Table 1 Laboratory Analysis of M1MP AUTOCAP Propellant

LABORATORY ANALYSIS OF M1MP VARIANT AUTOCAP PROPELLANT

(M4A2) 68308	Lots	J	K	L	30%J,70%L	13%J,28%K,59%L		M	N	LL
84.46	NC	85.17	85.07	85.20			OUTER WEB	85.72	85.49	85.37
10.12	DNT	9.65	9.69	9.73				9.21	9.70	9.47
5.42	UBP	5.18	5.24	5.07				5.01	4.81	5.16
1.04	(DPA)	1.04	1.06	1.05				1.03	1.05	1.19
1.21	(K_2SO_4)	0.98	1.27	1.16				1.11	1.12	0.98
0.54	TV	1.16	0.96	1.30			INNER WEB	1.04	1.07	0.96
0.10	RS	0.56	0.36	0.80				0.54	0.57	0.28
0.44	H_2O	0.60	0.60	0.50				0.50	0.50	0.68
	Density	1.5553	1.5420	1.5637	1.5610	1.5563		1.5518	1.5515	1.5293
	Screen Den	0.8079	0.7818	0.6745	0.7144	0.7218		0.8733	0.8721	0.7368
	Hygroscopicity,%	0.45	0.44	0.43	0.43	0.43		0.66	0.53	
0.4336	Length (in)	0.2000	0.4551	0.9729	0.4559	0.5661		0.4335	0.4363	0.969
0.1927	Dia (in)	0.1910	0.1944	0.1969	0.1965	0.1946		0.1972	0.2010	0.196
1.18	Length var%	4.10	0.84	0.90	74.87	51.54	Web dif%	29.40	-20.81	2.81
0.0163	Perf (in)	0.0151	0.0155	0.0159	0.0160	0.0147		0.0170	0.0175	0.0151
0.0360	Av web (in)	0.0381	0.0381	0.0380	0.0382	0.0377	INNER WEB	0.0315	0.0418	0.0376
2.25	L:D ratio	1.05	2.34	4.95	2.32	2.91	OUTER WEB	0.0424	0.0339	4.95
11.8	D:d ratio	12.69	12.53	12.37	12.31	13.24		11.62	11.49	12.96
	RQ	98.07	98.97	99.10	98.42	98.11		102.07	102.88	97.40
	RF	100.92	100.98	99.93	99.72	100.14		101.40	101.65	98.68
	(Std 68308)						L:D ratio	2.20	2.17	

LABORATORY ANALYSIS OF M1MP VARIANT AUTOCAP PROPELLANT (155 mm Howitzer - M4A2 charge)

Lots	P	Q	R	S	T	U	V	W
NC	84.74	85.02	85.23	84.97	85.29	84.73	85.07	85.20
DNT	9.65	9.78	9.60	9.60	9.64	9.97	9.45	9.66
DBP	5.61	5.20	5.17	5.43	5.07	5.30	5.48	5.14
(DPA)	1.10	1.07	1.11	1.01	1.06	1.07	0.99	1.02
(K_2SO_4)	0.62	0.53	0.57	0.53	2.08	2.10	2.12	2.24
TV	0.95	2.49	0.69	1.83	1.36	2.67	0.82	2.30
RS	0.18	0.49	0.11	0.03	0.53	0.27	0.17	0.17
H_2O	0.77	2.00	0.58	1.80	0.83	2.40	0.65	2.13
Density (g/cc)	1.5239	1.5307	1.5251	1.5201	1.5377	1.5326	1.5405	1.5286
Screen Den	0.7507	0.7512	0.7385	0.7425	0.7656	0.7616	0.7596	0.7595
Length (in)	0.5256	0.5308	0.3935	0.3882	0.5301	0.5279	0.3957	0.3942
Dia (in)	0.2379	0.2407	0.1763	0.1757	0.2366	0.2355	0.1774	0.1788
Perf (in)	0.0233	0.0241	0.0168	0.0172	0.0230	0.0221	0.0169	0.0165
Web (inner)	0.0420	0.0423	0.0318	0.0313	0.0418	0.0425	0.0316	0.0318
Web (outer)	0.0430	0.0429	0.0318	0.0317	0.0429	0.0430	0.0326	0.0326
Length var %	1.11	0.78	1.31	1.52	1.01	1.37	0.91	1.29
Dia var %	2.24	1.30	2.77	3.79	2.05	2.01	3.13	4.06
L:D ratio	2.21	2.21	2.23	2.21	2.24	2.242	2.23	2.21
D:d ratio	10.20	10.00	10.46	10.22	10.28	10.63	10.52	10.86
Hygroscopicity %	0.11	-0.57	0.57	-0.86	0.10	-1.01	0.32	-0.90
Heat exp (cal/g)	766.3	767.3	766.5	769.8	759.7	761.7	764.2	765.2
RC	89.57	79.94	118.83	107.47	86.03	73.72	115.24	101.83
RF (68308 stand)	100.69	98.64	101.75	100.02	97.96	94.72	99.78	97.05

TABLE 16 (CONTINUED)*

* Geometry, total volatiles, potassium sulfate study.

(Wood sulfite cellulose)

Table 17 Ballistic Firings of M1MP AUTOCAP Propellant

Ballistic Firings of Autocap M1 Propellant Lots J-N:

Lot	Zone 5		Zone 7	
Ref	1274	(15.15)	1872	(38.7)
	1253	(13.85)	1864	(37.4)
	1250	(13.6)	1868	(38.05)
	1264	(14.45)	1873	(38.45)
AV	1260.3	(14.26)	1869.3	(38.15)
SD	10.96	(0.69)	4.11	(0.57)
J	1270	(15.1)	1896	(41.85)
	1252	(13.9)	1885	(40.2)
	1255	(14.0)	1902	(43.0)
	1243	(13.45)	1891	(40.95)
AV	1255.0	(14.11)	1893.5	(41.50)
SD	11.23	(0.70)	7.23	(1.21)
K	1263	(14.75)	1850	(36.2)
	1253	(13.95)	1864	(37.6)
	1241	(13.4)	1864	(37.75)
	1254	(14.0)	1870	(38.55)
	1252.8	(14.03)	1862.0	(37.53)
	9.03	(0.55)	8.48	(0.98)
L	1259	(14.4)	1838	(34.8)
	1234	(13.0)	1843	(34.6)
	1243	(13.4)	1839	(34.6)
	1251	(13.85)	1835	(33.85)
	1246.8	(13.66)	1838.8	(34.46)
	10.72	(0.60)	3.30	(0.42)
JL	1256	(14.4)	1847	(35.5)
	1236	(13.05)	1843	(35.05)
	1232	(13.0)	1844	(34.85)
	1240	(13.35)	1847	(34.5)
	1241.0	(13.45)	1845.3	(34.98)
	10.52	(0.65)	2.06	(0.42)
JKL	1253	(14.3)	1846	(35.5)
	1242	(13.55)	1846	(35.45)
	1224	(13.0)	1847	(35.1)
	1230	(13.25)	1848	(35.15)
	1237.3	(13.53)	1846.7	(35.3)
	12.89	(0.56)	0.96	(0.20)

Lot	Zone 5		Zone 7	
M	1242	(14.2)	1852	(35.55)
	1215	(13.2)	1843	(34.95)
	1237	(13.85)	1847	(35.7)
	1230	(13.75)	1846	(35.35)
	1230.0	(13.75)	1847.0	(35.39)
	11.75	(0.41)	3.74	(0.35)
N	1252	(14.0)	1860	(36.55)
	1237	(13.3)	1857	(35.85)
	1260	(14.2)	1850	(35.8)
	1253	(13.95)	1856	(36.0)
	1250.5	(13.86)	1855.8	(36.05)
	9.68	(0.39)	4.19	(0.34)
Ref	1255	(12.6)	1875	(37.8)
	1258	(13.3)	1870	(37.0)
	1241	(13.4)	1866	(37.2)
	1251	(13.4)	1876	(38.7)
AV	1251.3	(13.2)	1871.8	(37.7)
SD	7.41	(0.39)	4.65	(0.76)
JKLL	1225	(12.6)	1844	(34.8)
	1225	(12.6)	1841	(34.4)
	1236	(13.0)	1851	(35.0)
	1249	(13.3)	1851	(35.4)
	1241	(13.2)	1848	(35.6)
	1238	(13.0)	1857	(36.6)
	1236	(12.8)	1848	(35.6)
	1241	(13.0)	1850	(35.2)
	1236	(13.0)	1867	(37.9)
	1237	(12.9)	1849	(35.8)
	1239	(13.0)	1857	(36.7)
	1242	(13.2)	1846	(34.2)
AV	1237.0	(12.97)	1840	(34.4)
SD	6.72	(0.22)	1869	(37.7)
			1848	(34.8)
			1862	(36.4)
			1851.7	(35.66)
			8.53	(1.13)

Reference propellant RAD 68308.
Zone 7 CW - 212.4 oz.
Zone 5 CW - 112.8 oz.
Velocity in fps.
Values in parentheses are peak kpsi chamber pressure.
Average and standard deviation are given for each set of firings.

Table 17 (Continued)

Ballistic Firings of Autocap M1 Propellant Lots P-W:

Lot	Zone 5		Zone 7	
Ref	1254	(13.6)	1861	(37.2)
	1250	(13.85)	1853	(36.05)
	1233	(13.45)	1858	(37.7)
	1253	(13.85)	1850	(35.9)
AV	1247.5	(13.69)	1655.5	(36.7)
SD	9.8	(0.20)	4.93	(0.88)
P	1181	(11.75)	1814	(31.3)
	1174	(11.55)	1830	(33.55)
	1166	(11.35)	1823	(32.15)
	1186	(11.65)	1831	(33.65)
	1176.8	(11.57)	1824.5	(32.66)
	8.7	(0.17)	7.85	(1.14)
Q	1143	(11.00)	1763	(28.1)
	1154	(11.05)	1773	(28.8)
	1150	(11.10)	1776	(29.15)
	1147	(10.85)	1780	(29.9)
	1148.5	(11.05)	1773.0	(28.99)
	4.7	(0.05)	7.26	(0.75)
R	1313	(17.25)	1935	(49.9)
	1309	(16.8)	1934	(49.8)
	1312	(17.2)	1939	(50.25)
	1315	(17.0)	1938	(50.15)
	1312.3	(17.06)	1938.3	(50.02)
	2.5	(0.21)	2.5	(0.21)
S	1310	(17.6)	1926	(48.75)
	1321	(17.5)	1923	(48.5)
	1317	(18.05)	1939	(50.7)
	1311	(16.95)	1931	(49.75)
	1314.8	(17.52)	1929.8	(49.4)
	5.2	(0.45)	7.0	(1.0)

Lot	Zone 5		Zone 7	
T	1174	(11.65)	1798	(31.85)
	1167	(11.35)	1803	(32.1)
	1177	(11.85)	1813	(32.6)
	1162	(11.1)	1807	(32.45)
	1170.0	(11.49)	1805.3	(32.25)
	6.8	(0.33)	6.34	(0.34)
U	1111	(10.15)	1719	(26.2)
	1098	(9.90)	1709	(25.8)
	1093	(9.90)	1720	(26.1)
	1124	(10.5)	1727	(26.6)
	[illegible]	(10.11)	1718.8	(26.18)
	13.9	(0.29)	7.4	(0.33)
V	1298	(16.7)	1915	(48.35)
	[illegible]	(16.5)	1917	(47.3)
	1301	(16.65)	1918	(49.05)
	1297	(16.3)	1918	(49.4)
	1298.7	(16.54)	1917.0	(48.52)
	2.0	(0.18)	1.1	(0.93)
W	1275	(15.2)	1886	(43.95)
	1271	(15.4)	1883	(43.95)
	1274	(15.45)	1884	(43.4)
	1274	(15.3)	1880	(43.4)
	1273.5	(15.34)	1883.3	(43.7)
	1.7	(0.11)	2.5	(0.32)

Lots:	J-N	Time Fired:	Sept. 1974
	P-W		Dec. 1974
	JKLL		May 1975

Therefore in Table 18, and for all further comparisons, the mean reference velocities are made equal to 1855.5 and 1247.5 (zone 7 and 5 respectively) from the P through W lots. The mean reference velocities for the other firings are adjusted to these values. For example, the velocity difference is (1855.5-1869.3) = a decrease of 13.8 fps for zone 7 for lots J through N. A similar procedure is used for peak breech pressure.

B. CLOSED BOMB FIRINGS OF LOTS J through W

As noted in the section on Radford AAP, six firings of each production lot were conducted in the 192 cm^3 bomb at 0.2 g/cm^3 loading. Because the programming software produced a bias effect on the RQ computer computation when a 0.1 millisecond sample rate on the pressure signal was used, all firings were repeated at 0.2 ms sample interval.

The pressure data for this second series is given in Appendix B, where the reported RC smooth pressure data is given to an accuracy of about 50 psi for 152 records of 90 points each (the 33 points beyond peak pressure were omitted in this listing). Radford storage records have 123 points/firing, and the 90th point was already beyond peak pressure.

Since the voltage calibration signal prior to each firing was not available, the given data was unsmoothed by the Radford RC algorithm: $P_i = (4\ \overline{P}_i - \overline{P}_{i-1})/3$ (bar refers to RC smooth data) preliminary to other numerical methods of analysis; and 8, 12, 16, and 20 kpsi were used as reference pressure points for RQ calculation. (The six hexadecimal records had indicated these four values were reasonable ones to use).

Figure 25 to 30 are Radford closed bomb firings plotted for each lot configuration. The six closed bomb firings are plotted together with the same scaling from points 16 to 71 from the 123 point records available. Also each group of 6 firings was displaced exactly one inch vertically on the original graph (4 psi/microsecond) from one another for direct comparison. The graphs are self explanatory. All the Radford data (0.2 ms sample time) are plotted for two numerical methods used on the raw pressure data:

a) Radford RC method;
b) 9 point cubic least square fit.

The difference between the two methods is evident from shift of peak on the plots, details in early ignition phase (at least for single base propellant), and the high pressure finite slope.

Table 18 Summary Ballistic Performance of AUTOCAP Propellant

Summary Ballistic Perrormance of Autocap Propellants:

LOT	ZONE 7						ZONE 5					
	VELOCITY (fps)			PRESSURE (kpsi)			VELOCITY (fps)			PRESSURE (kpsi)		
	Obs	Adj	S.D.	Obs	Adj	S.D.	Obs	Adj	S.D.	Obs	Adj	S.D.
Stand	1869.3	(1855.5)	4.11	38.15	(36.71)	0.57	1260.3	(1247.5)	10.96	14.26	(13.69)	0.69
J	1893.5	(1879.7)	7.23	41.5	(40.06)	1.21	1255.0	(1242.2)	11.23	14.11	(13.54)	0.70
K	1862.0	(1848.2)	8.48	37.53	(36.09)	0.98	1252.8	(1240.0)	9.03	14.03	(13.46)	0.55
L	1838.8	(1825.0)	3.3	34.46	(33.02)	0.42	1246.8	(1234.0)	10.72	13.56	(13.09)	0.60
JL	1845.3	(1831.5)	2.06	34.98	(33.54)	0.42	1241.0	(1228.2)	10.52	13.45	(12.88)	0.65
JKL	1846.7	(1832.9)	0.96	35.30	(33.86)	0.20	1237.3	(1224.5)	12.89	13.53	(12.96)	0.56
M	1847.6	(1833.2)	3.74	35.39	(33.95)	0.33	1230.0	(1217.2)	11.75	13.75	(13.12)	0.41
N	1855.8	(1842.0)	4.19	36.05	(34.61)	0.34	1250.5	(1237.7)	9.68	13.86	(13.29)	0.39
Stand	1871.8	(1855.5)	4.65	37.68	(36.71)	0.76	1251.3	(1247.5)	7.41	13.85	(13.69)	0.19
JKLM	1851.8	(1835.5)	8.53	35.66	(34.69)	1.13	1237.0	(1233.2)	6.72	12.97	(13.11)	0.22
Stand	1855.5		4.93	36.71		0.88	1247.5		9.8	13.69		0.20
P	1824.5		7.85	32.66		1.14	1176.8		8.7	11.58		0.17
Q	1773.0		7.26	28.59		0.7	1148.5		4.7	11.00		0.21
R	1938.3		2.5	50.03		0.21	1312.3		2.5	17.05		0.21
S	1929.8		7.0	49.43		1.01	1314.8		5.2	17.53		0.45
T	1805.3		6.34	32.25		0.34	1170.0		6.8	11.49		0.33
U	1718.8		7.4	26.18		0.33	1106.5		13.5	10.11		0.28
V	1919.0		1.4	43.53		0.93	1298.7		2.3	16.54		0.18
W	1883.3		2.5	43.68		0.32	1273.5		1.7	16.34		0.11

Fired in Howitzer, 155-mm, M126, M4A2 propelling charge.
Calibration propellant: RAD 68308
Charge weight zone 7, 212.4 oz.
Charge weight zone 5, 112.8 oz.
The observed velocities represent a mean of four firings, except for lot JKLL where there were 16 firings at zone 7, and 12 and zone 5.
The adjusted values are referred to the mean value of the standard fired for the P-W lots.

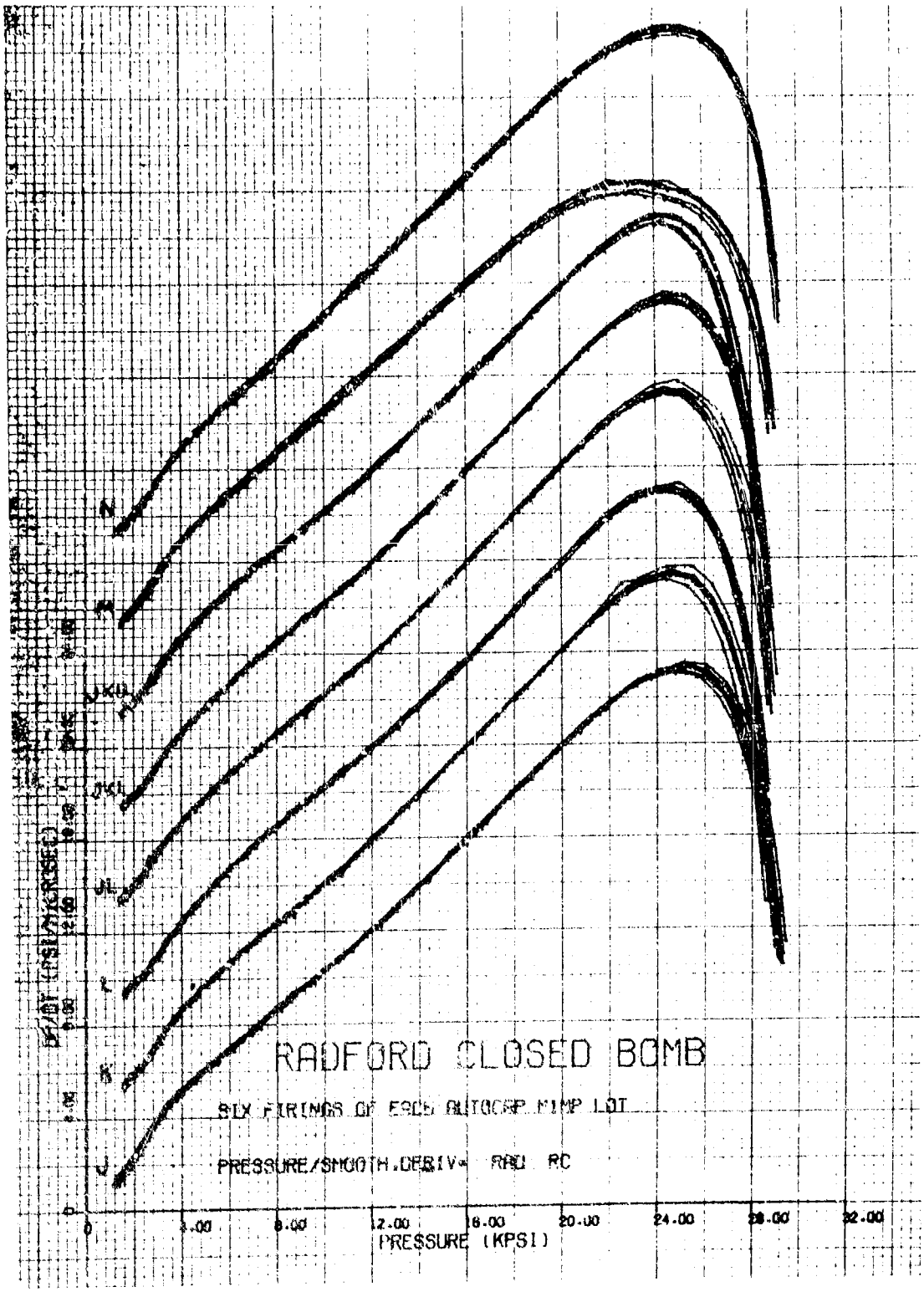


Figure 25 Radford, J-N Plots, RC Fit

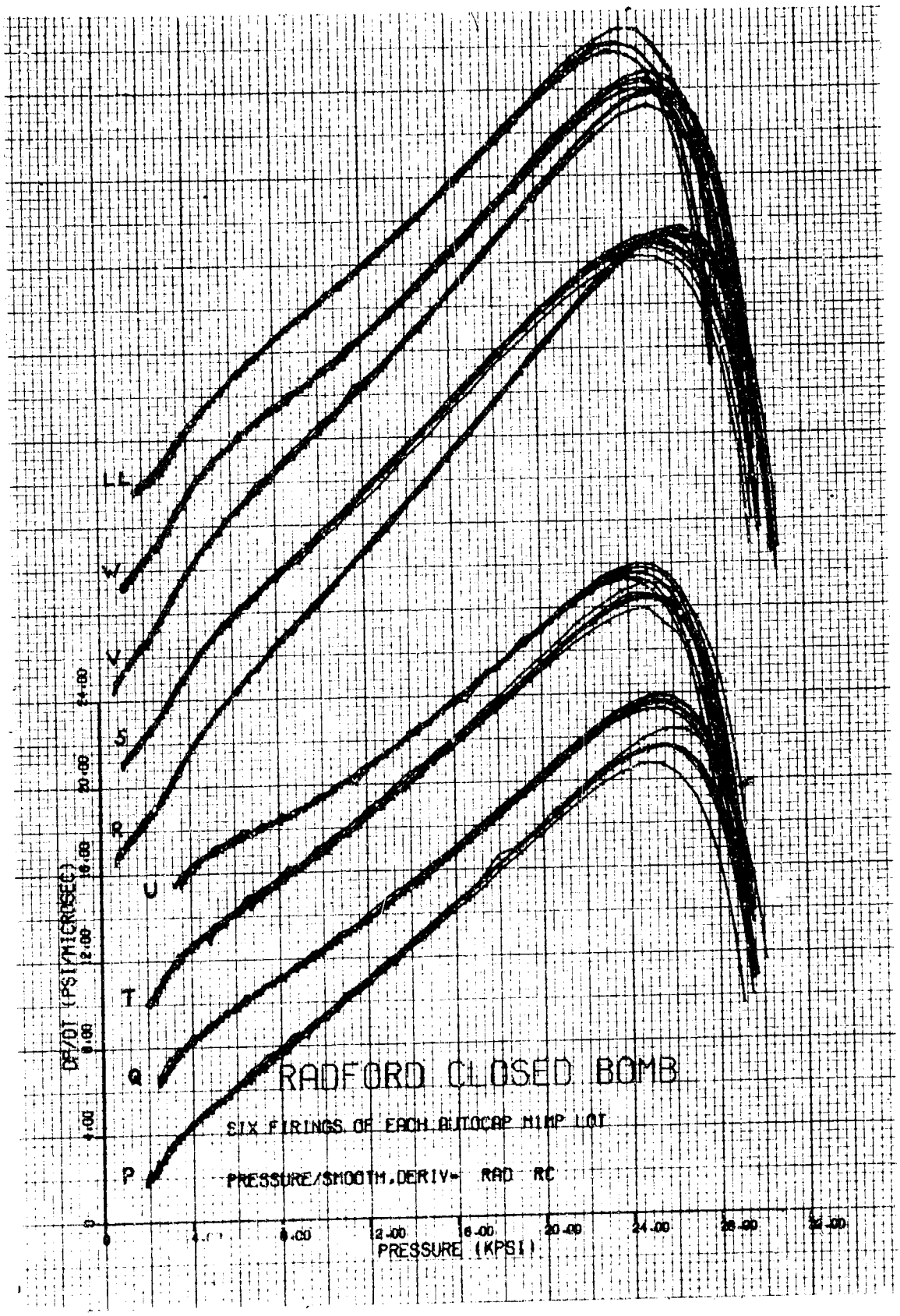


Figure 26 Radford, P-LL Plots, RC Fit

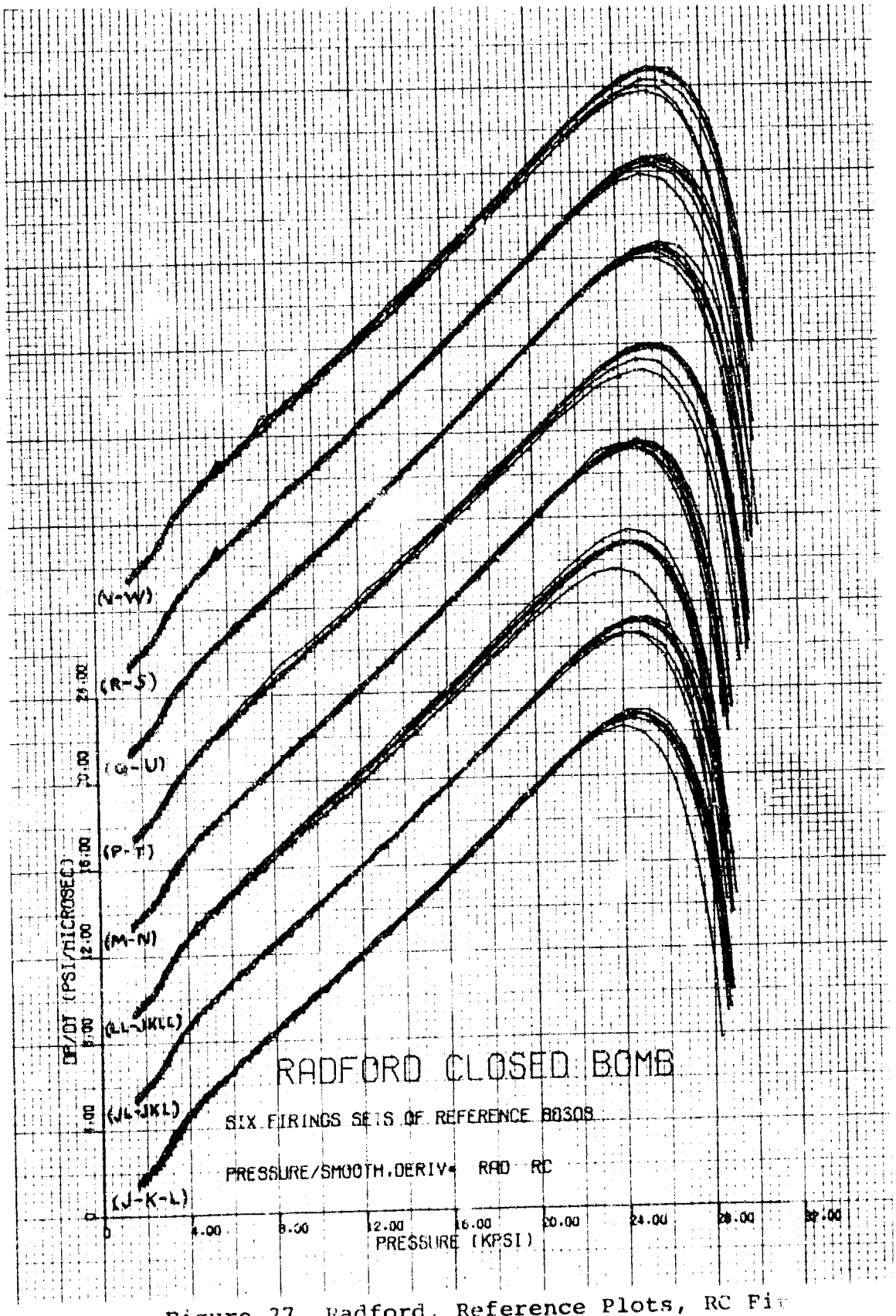


Figure 27 Radford, Reference Plots, RC Fi

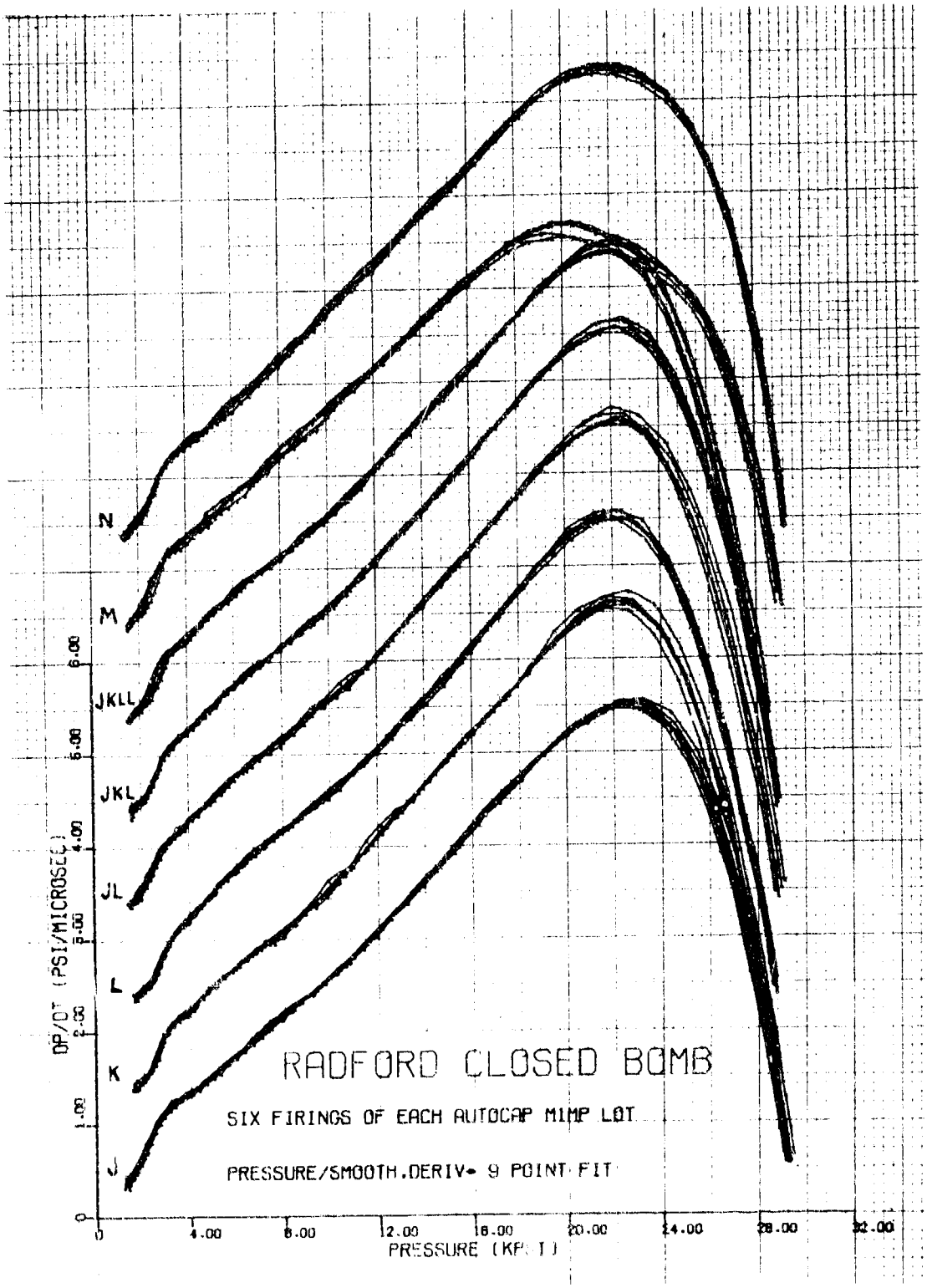


Figure 28 Radford, J-N Plots, 9 Point Fit

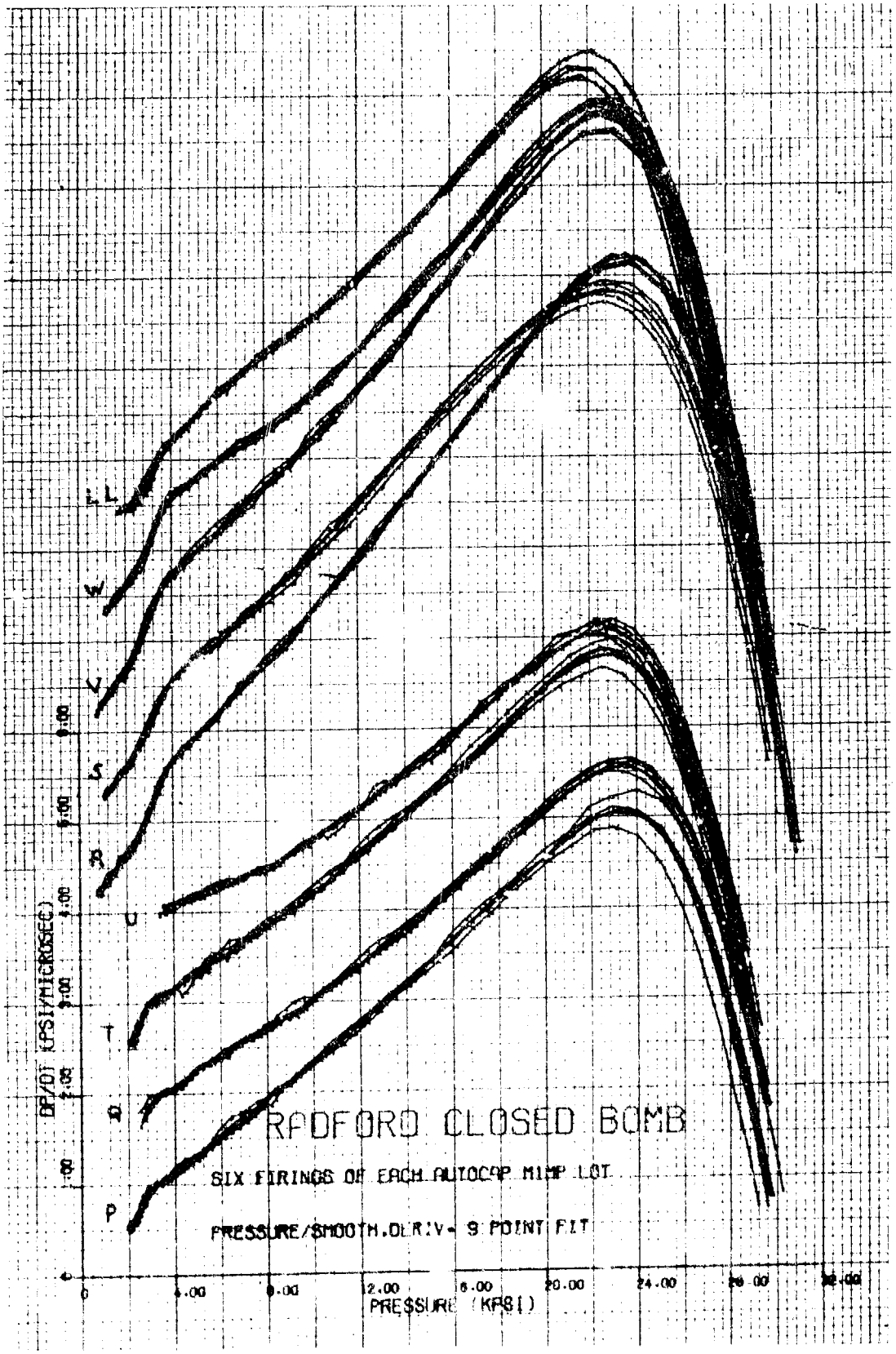


Figure 29 Radford, P-dP/dt Plots, 9 Point Fit

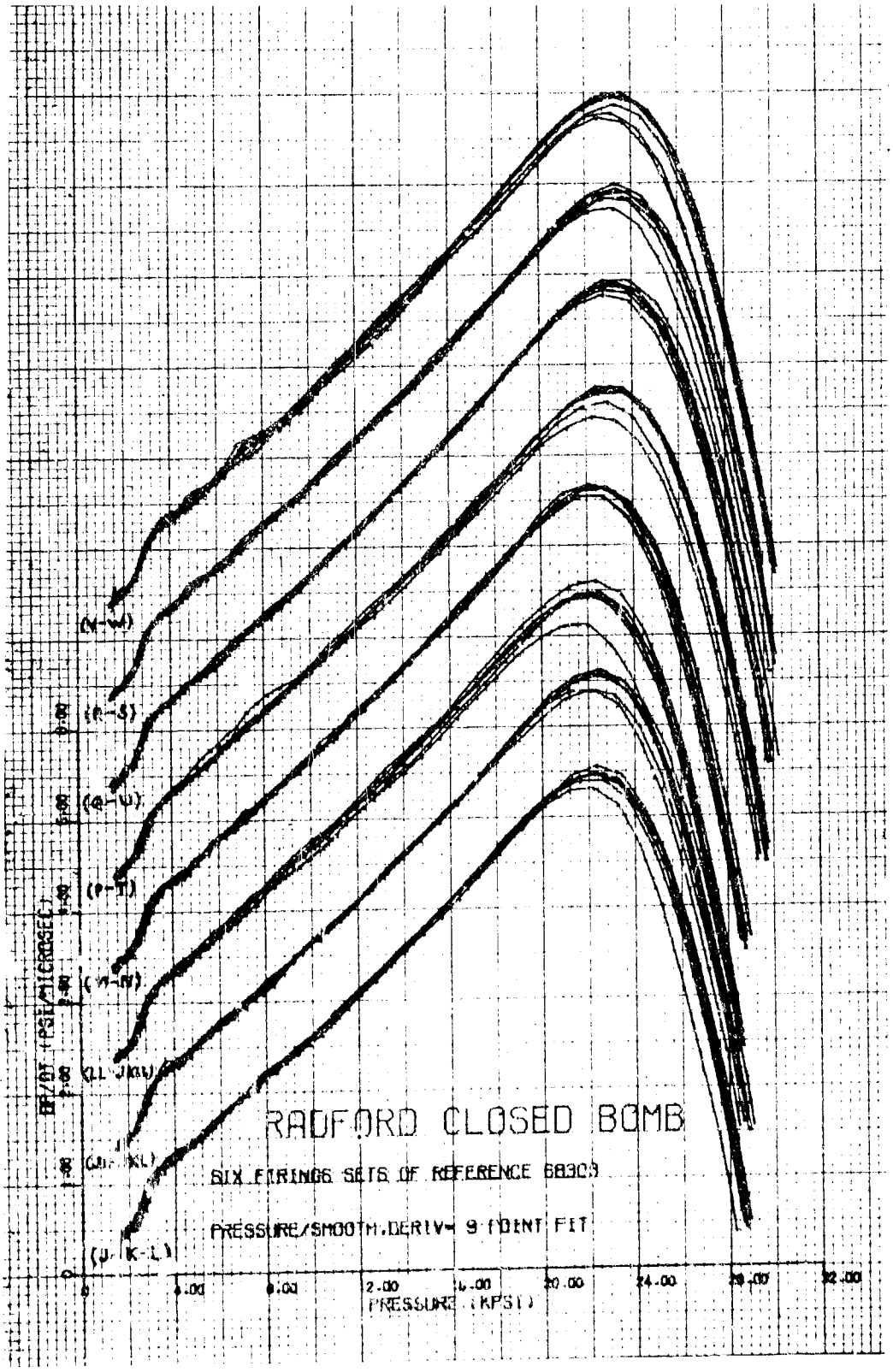


Figure 30 Radford, Reference Plots, 9 Point Fit

Figure 31 to 36 are Picatinny firings, which were three per lot and are graphed in the same manner as Radford's. The sample rate was 0.096 ms, and the data was plotted from 800 psi to 98% of peak pressure for each firing. Three numerical methods were used:

a) 19 point cubic least square fit;
b) 9 point cubic least square fit (odd points only);
c) 9 point cubic least square fit (all points).

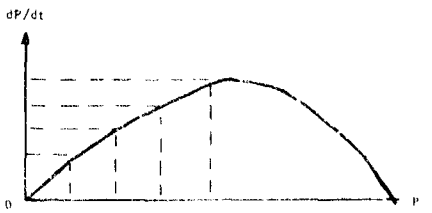
It is evident methods a) and b) give similar results indicating that a 0.2 sample period would be tolerable. However, the 9 point fit for all points most probably introduces unwanted numerical fluctuations.

C. CORRELATION OF BALLISTICS AND CLOSED BOMB

C.1 Plots

There were several methods used to analyze the closed bomb data from both Radford and Picatinny, with most of the results referring to Radford data. For RQ type calculation, the following pressure intervals were used:

DP/DT points	Pressure Range (kpsi)	Pressure Interval (kpsi)
4	8-20	4 (MIL-STD type)
14	8-20	1
12	4-28	2
22	4-28	1



RQ, AQ, and RQA were calculated for each test record by each of the above approaches where:

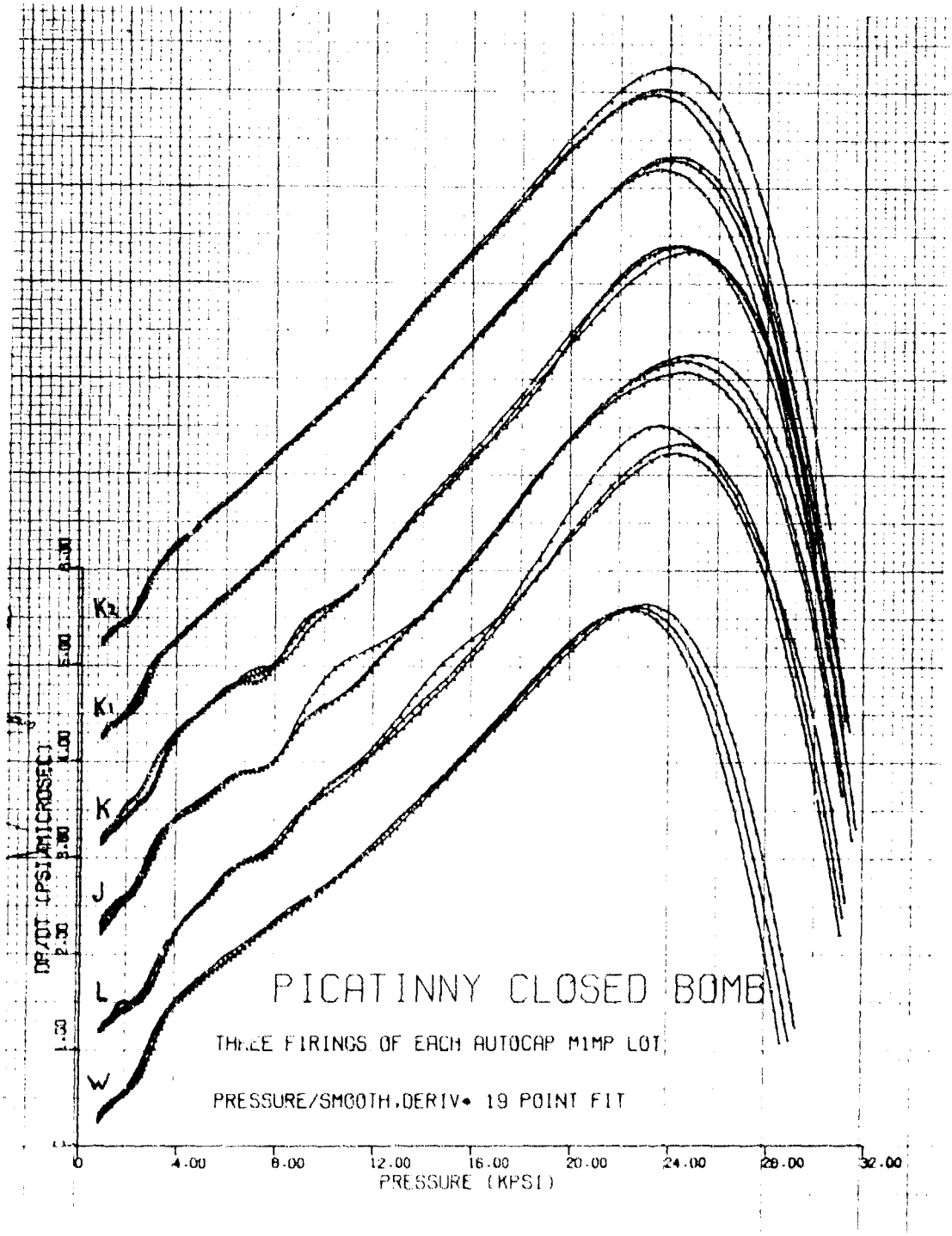


Figure 31 Picatinny, W-K Plots, 19 Point Fit

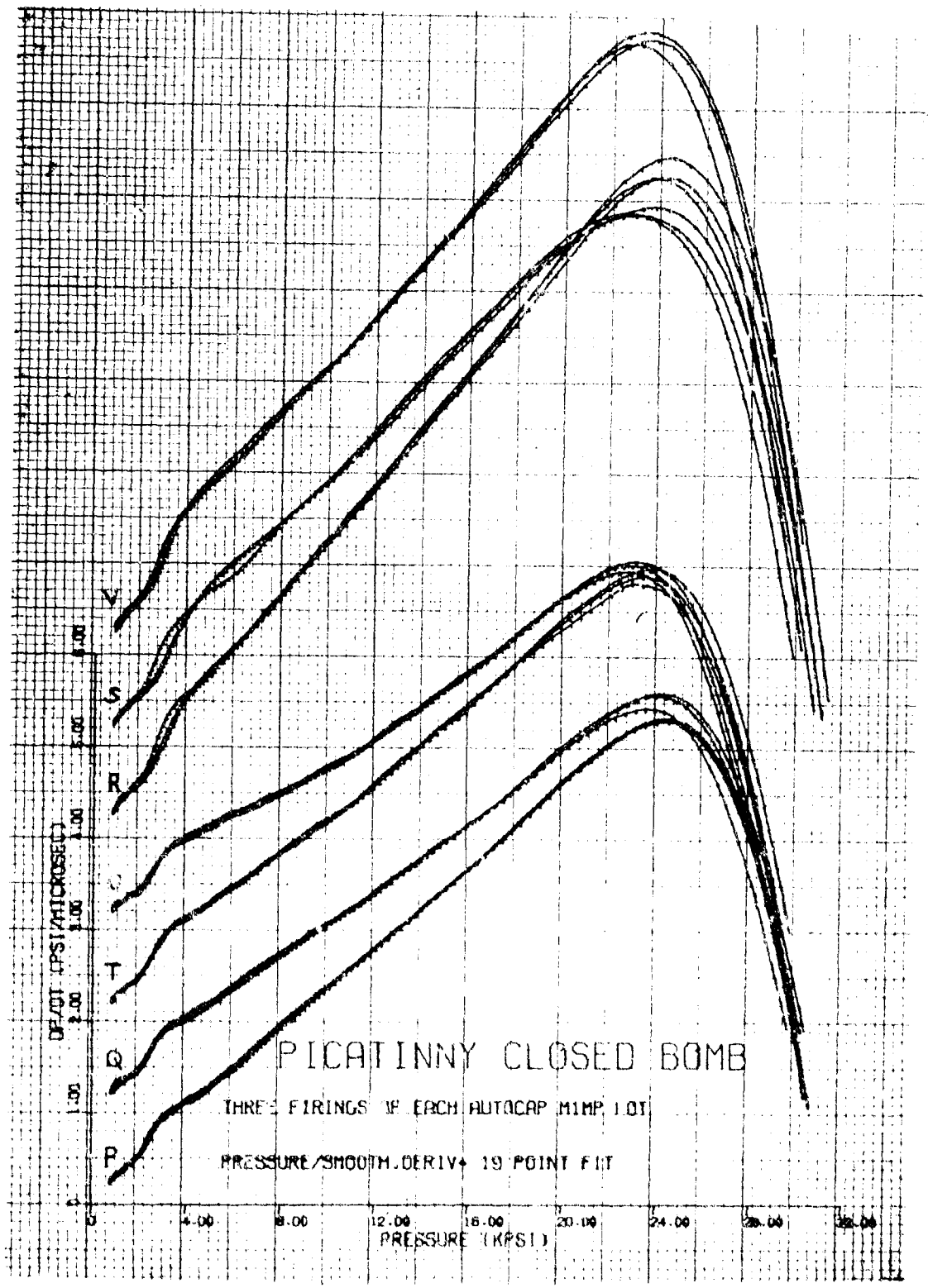


Figure 32 Picatinny, P-V Plots, 19 Point Fit

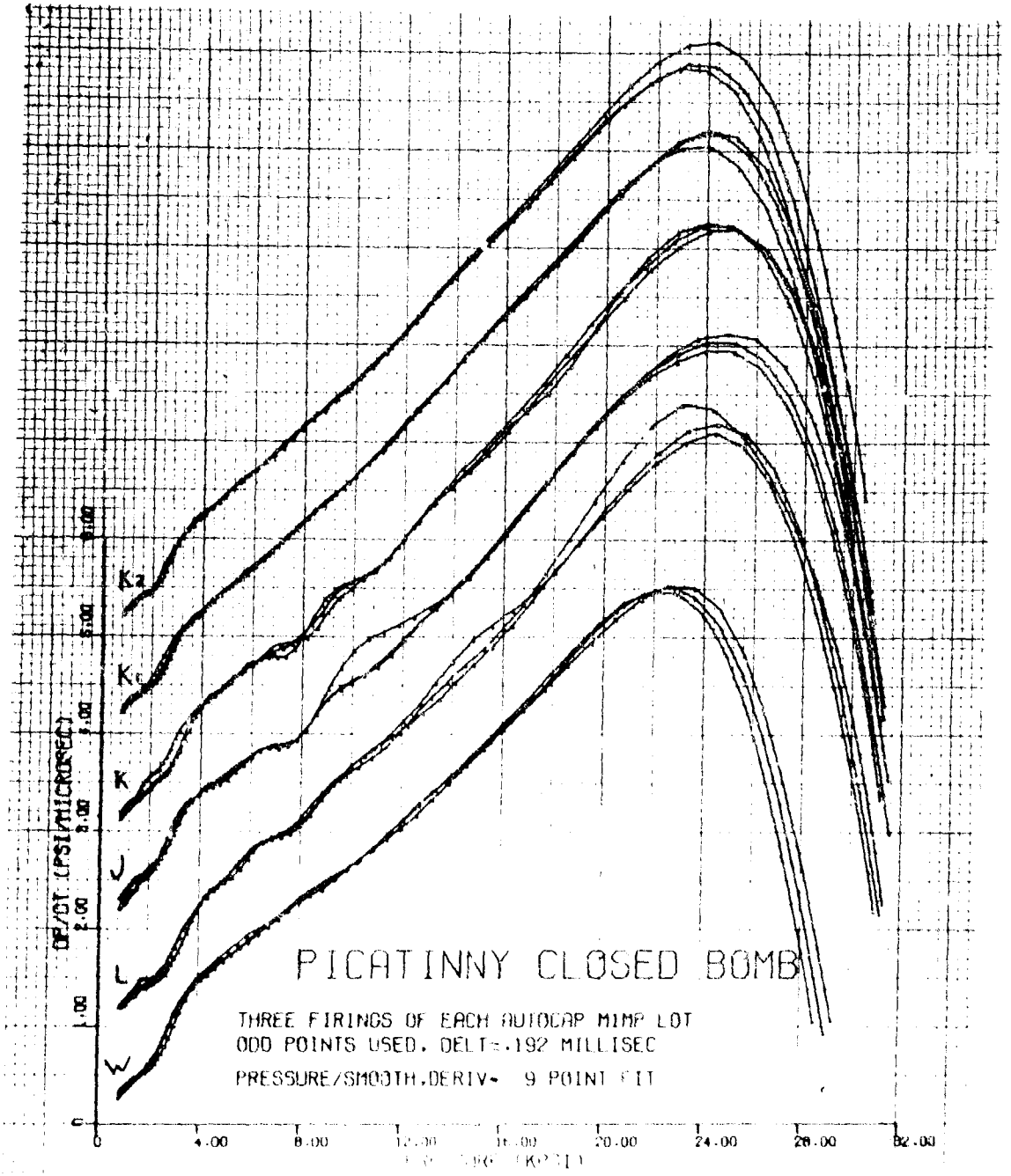


Figure 33 Picatinny, W-K Plots, 9 (odd)Point Fit

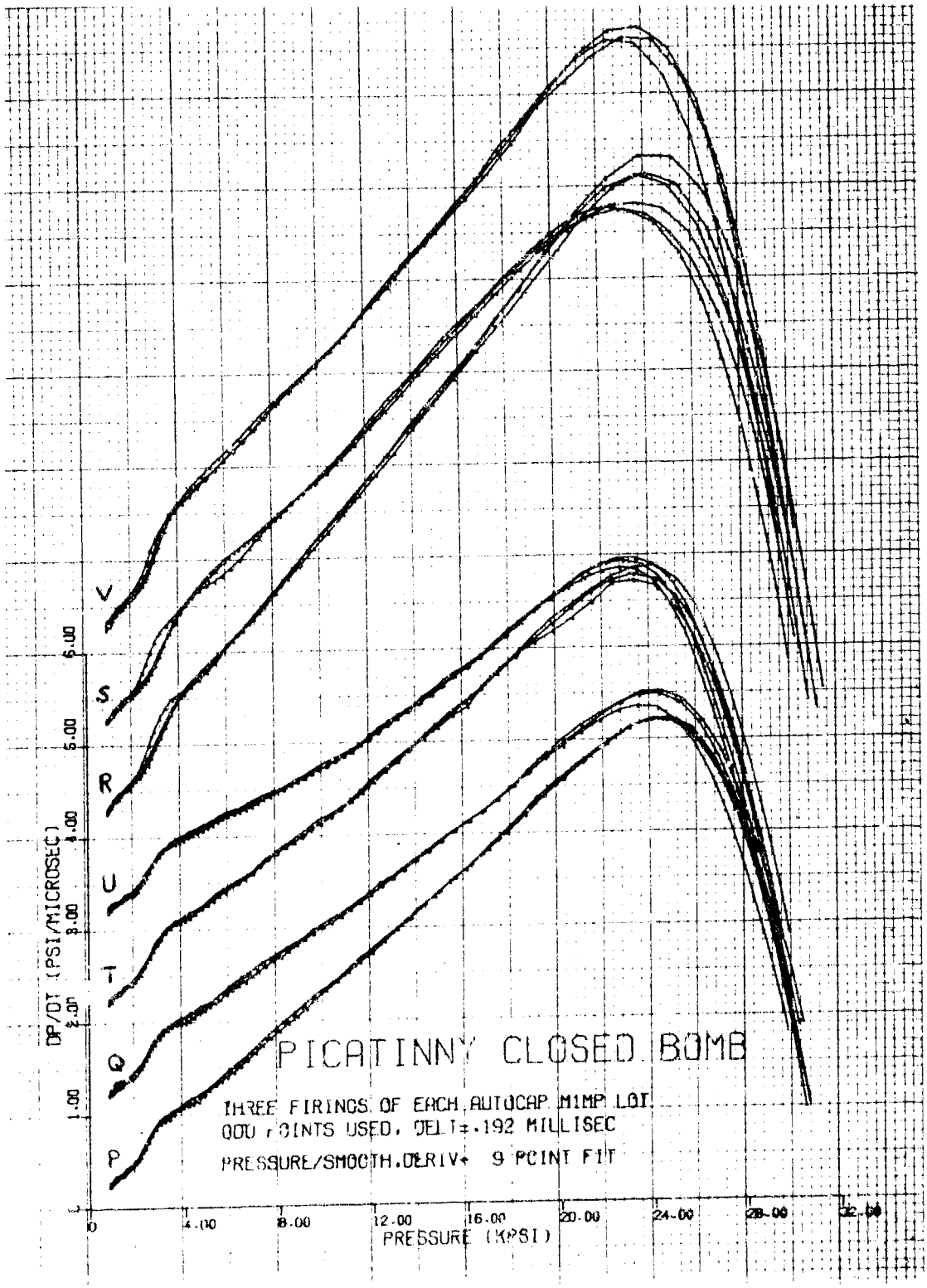


Figure 34 Picatinny, P-V Plots, 9 (odd)Point Fit

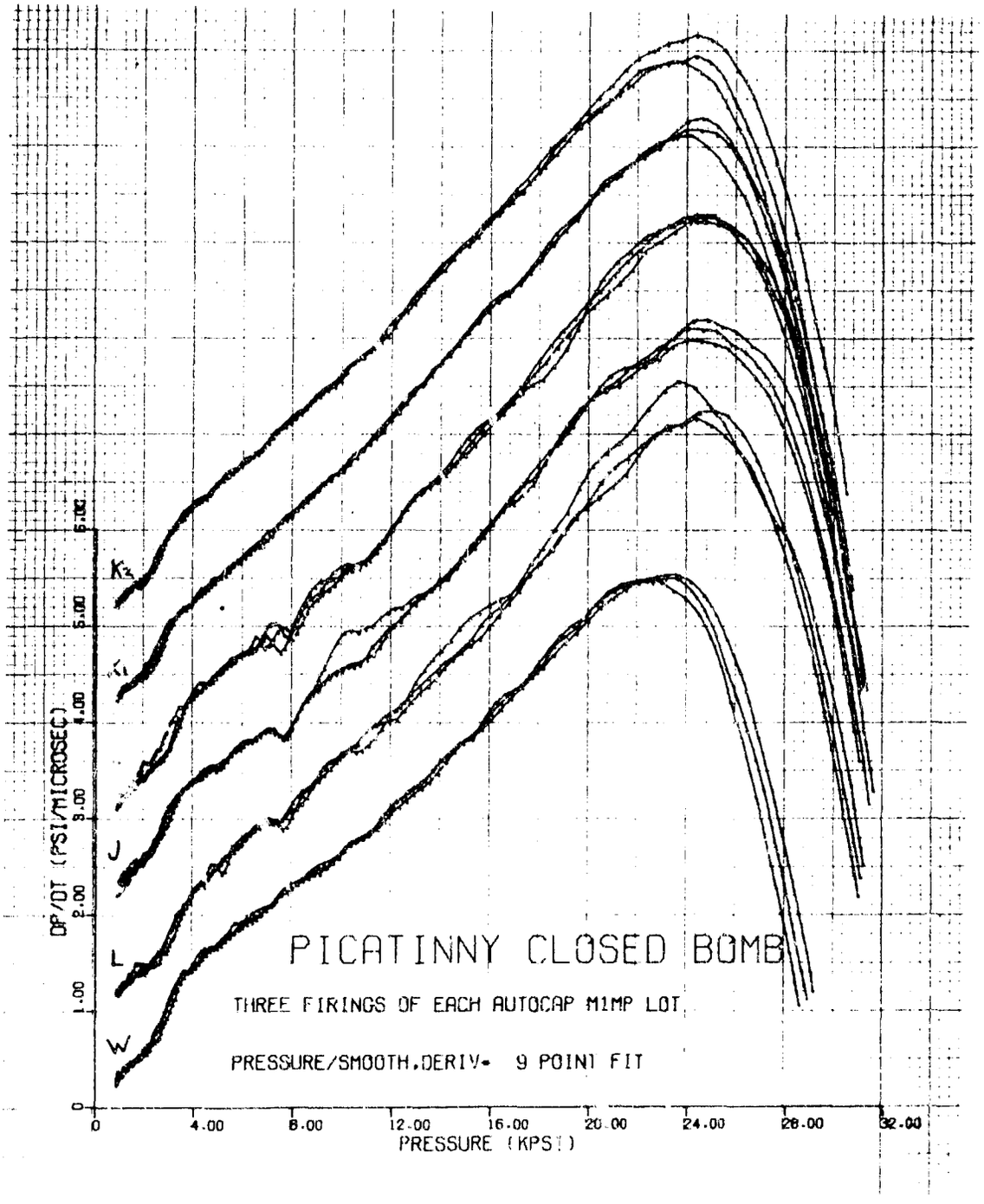


Figure 35 Picatinny, W-K Plots, 9 Point Fit

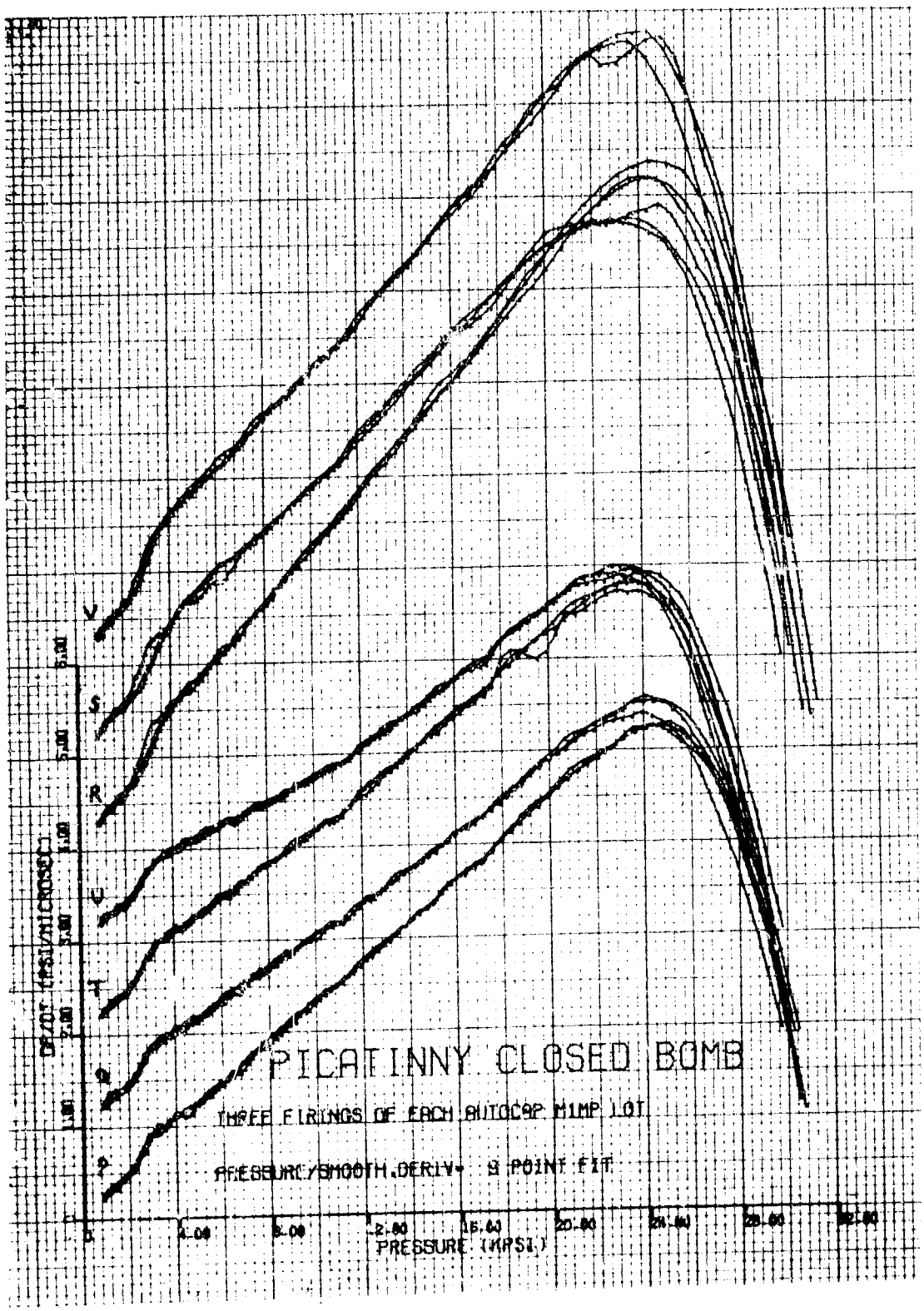


Figure 36 Picatinny, P-V Plots, 9 Point Fit

$$RQ \text{ (percent)} = \frac{1}{M} \sum_{i=1}^{M} \left(\frac{100}{N} \sum_{j=1}^{N} \frac{T_{ij}}{R_{ij}} \right)$$

$$AQ \text{ (psi/microsecond)} = \frac{1}{M} \sum_{i=1}^{M} \left(\frac{1}{N} \sum_{j=1}^{N} T_j \right)$$

i refers to the number of firings, maximum is M.
j refers to the number of data points per firing, maximum is N.
T_{ij} and R_{ij} refer to dp/dt values for test and reference propellent

AQ is absolute quickness, and does not use reference propellant data. It is somewhat like RQ in that it is a crude integration of the dp/dt vs p plot. AQ numerically represents a crude average dp/dt over the pressure range considered.

RQA has the same definition as RQ except with R_{ij} replaced by $\overline{R_j}$:

$$\overline{R_j} = \frac{1}{M} \sum_{i=1}^{M} R_{ij}$$

RQA is the RQ by averaged reference firings where the reference propellant firing dp/dt values at a specific pressure were averaged before this mean was used to divide into the respective test propellant firing dp/dt values at that specific pressure. Also the following additional values were calculated for each pertinent record:

1. Area under closed bomb curve: $\text{AREA (kpsi}^2\text{/ms)} = \int_0^{P_{MAX}} (dp/dt)\, dP$

2. Area under p vs t curve: "IMPULSE" (psi-sec) $= \int_{0.1P.P.}^{0.9P.P.} (P)\, dt$

3. Relative force: $RF = \frac{100}{M} \sum_{i=1}^{M} \left(\frac{T_{PMAXi}}{R_{PMAXi}} \right)$

4. Absolute force: $AF = \frac{1}{M} \sum_{i=1}^{M} T_{PMAXi}$

where $T_{pmax\ i}$ and $R_{pmax\ i}$ are maximum pressure for test and reference propellant for ith firing.

A typical calculation of RQ and RF is illustrated for a series of 6 firings (i = 3 and j = 4), with the use of metric units (megapascals for pressure, and megapascals/millisecond for dp/dt). (One megapascal equals 145.037 pounds per square inch).

$$\text{RQ for 1st firings} = \frac{100}{4}\left|\frac{15.065}{14.955} + \frac{21.264}{21.167} + \frac{28.717}{28.110} + \frac{35.694}{35.088}\right| = 101.270$$

$$\text{RQ for 2nd firings} = \frac{100}{4}\left(\frac{15.382}{14.845} + \frac{21.381}{21.174} + \frac{28.841}{27.896} + \frac{35.763}{35.370}\right) = 102.273$$

$$\text{RQ for 3rd firings} = \frac{100}{4}\left(\frac{14.872}{14.803} + \frac{20.988}{20.871} + \frac{28.544}{27.600} + \frac{35.639}{35.177}\right) = 101.440$$

The above values are averaged to obtain the mean relative quickness, RQ = 101.66. The RQ range is 1.00.

The standard deviation is 0.54.

$$\text{RF for 1st firings} = 100\left(\frac{202.680}{196.798}\right) = 102.989$$

$$\text{RF for 2nd firings} = 100\left(\frac{204.520}{199.370}\right) = 102.583$$

$$\text{RF for 3rd firings} = 100\left(\frac{205.624}{200.494}\right) = 102.559$$

The mean relative force becomes, RF = 102.71. The RF range is 0.43. The standard deviation is 0.24.

All the above were done after treating the unsmoothed data by both the RAD RC and the 9 point cubic fit method. In this approach, each series of six tests firings yielded 4x3x4x2 = 96 numerical characterizations. Also the mean and standard deviation were obtained for all records in each lot. (Much of this data is in computer printout listing from tables 22 to 54.)

To relate to ballistics, the mean howitzer velocities and peak chamber pressure for zones 5 and 7 were used and are listed in Table 19.

Table 19 'ZONE 7 AND 5 MEAN VELOCITY AND PEAK PRESSURE

LOT	V7(FPS)	V5(FPS)	PP7(KPSI)	PP5(KPSI)
J	1879.7	1242.2	40.06	13.54
K	1848.2	1240.0	36.09	13.46
L	1825.0	1234.0	33.02	13.09
JL	1831.5	1228.2	33.54	12.88
JKL	1832.9	1224.5	33.86	12.96
JKLL	1835.5	1233.2	34.69	13.11
M	1833.2	1217.2	33.95	13.12
N	1842.0	1237.7	34.61	13.29
P	1824.5	1176.8	32.66	11.58
Q	1773.0	1148.5	28.99	11.00
R	1938.3	1312.3	50.03	17.06
S	1929.8	1314.8	49.43	17.53
T	1805.3	1170.0	32.25	11.49
U	1718.8	1106.5	26.18	10.11
V	1917.0	1298.7	48.53	16.54
W	1883.3	1273.5	43.68	15.34

A simple linear regression fit was used for the data for the following lot selections:

1. All lots.
2. Lots R, V excluded (energetic lots).
3. Lots RVQU excluded (most and least energetic).
4. Lots RVQUPT excluded (most energetic and larger grain).
5. Lots JKLPQSTUW only (lot mixtures, web variations, energetic lots excluded).
6. All lots (log fit).

A linear regression line is plotted for all lots, and the corresponding correlation coefficient R is listed. (The coefficient of determination is R squared.)

For example, if the area under the dp/dt vs p curve were calculated for all lots, with a 9 point cubic fit, the regression equation for zone 7 velocity becomes (See Table 28).

$\boxed{VEL7 = 1518.6 + 3.504\ X}$ with a correlation coefficient R = 0.938, where X is the mean area for the lot.

X = 94.52 for lot J. Thus for lot J:

$\boxed{VEL7\ (for\ lot\ J) = 1849.8,}$ which is 30 fps below the reported mean for lot J (1879.7).

In the computer printouts, expressions as (J-K-L) refer to reference lot 68308 fired for lots J, K, and L. (JL-JKL) was fired for mixture lots JL and JKL.

Linear regression equations were calculated for peak gun pressure, but these correlations were poor as expected, and are listed only in Tables 27, 28 and 31. Correlation of ballistics with British Vivacity (involving dp/dt/p ratio) was poor and is not even reported.

Table 20 lists several of these equations, with a few two dependent variable ones. In deriving these equations, the unsmoothed closed bomb data was smoothed and differentiated with the 9 point cubic fit. Specific AQ, RQ, AF, RF, and AREA values can be obtained from appropriate computer listings.

Figure 37: This summary SCATTER PLOT plots all ballistic data (corrected velocities) and RQ as prescribed in MIL-STD with the RAD RC method. The intersections occur through the mean of the RQ and of the muzzle velocities for any particular lot. These RQ values are practically identical to those reported by Radford.

Figure 38: This SCATTER PLOT follows the same plot pattern as Figure 37, but the abscissa is the absolute quickness (no reference propellant firings).

Table 20

Several Linear Regression Equations for Closed Bomb-Ballistic Firings of AUTOCAP M1 Propellant Lots J-W. (155mm, M126, M4A2 charge)

	Zone 5		Zone 7	
ALL LOTS CONSIDERED:				
	V=880.0+99.2 AQ	0.930	V=1496.2+99.11 AQ	0.945
	V=114.1 AQ-18.22 AF+1367	0.942	V=97.85 AQ+1.516 AF+1456	0.944
	V=832.6+4.02 RQ	0.961	V=1469.6+3.84 RQ	0.933
	V=4.252 RQ-2.737 RF+1084	0.961	V=3.703 RQ+1.638 RF+1317	0.931
	V=905.2+3.473 AREA	0.915	V=1518.6+3.504 AREA	0.938
ALL LOTS CONSIDERED (log fit):				
	V=781.0+359.0 ln AQ	0.951	V=1400.1+356.7 ln AQ	0.960
	V=-495.9+376.5 ln RQ	0.961	V=203.2+358.5 ln RQ	0.929
LOTS R and V OMITTED:				
	V=753.3+137.9 AQ	0.970	V=1399.+128.93 AQ	0.960
	V=140.8 AQ-6.44 AF+933.6	0.971	V=122.6 AQ+13.44 AF+1024.	0.968

Table 20 (Cont'd)

V=791.1+4.48 RQ	0.957	V=1454.7+3.97 RQ	0.899
V=4.956 RQ-4.766 RF+1221.	0.962	V=3.852 RQ+1.157 RF+1351.	0.896
V=763.+5.121 AREA	0.965	V=1402.6+4.849 AREA	0.967

V - muzzle velocity (fps)
R - correlation coefficient
AQ, AF - absolute quickness, force (psi/microsec, kpsi)
RQ, RF - relative quickness, force (percent)
V represents the mean of four firings:
AQ, AF, RQ, and RF represent the mean of six firings.
AREA under dp/dt vs p curve.

The nine-point least squares smoothing-derivative was used with AQ calculated from 4-28 kpsi (Δp=2 kpsi), and RQ from 8-20 kpsi (Δp=4 kpsi).

In the following figures, only the mean values are plotted: ■ refers to zone 7; and + refers to zone 5 with a linear regression line plotted for all lots in each zone, and the correlation coefficient R.

Figure 39: AREA of DP/DT vs P: Also plotted in open rectangles is Picatinny data. There is close correlation between Picatinny and Radford data except for lots J, K, and L (Picatinny firing 9/23/74) where mechanical difficulty was experienced with the particular Picatinny pressure gage. Other Picatinny firings (11/13/74) show better correlation, but firings K1 and K2 (lot K) used as reference for lots P-W still stand high in regard to the Radford K value even though a trouble free gage was used.

Figure 40: RELATIVE FORCE. Poor correlation, as expected.

Figure 41: ABSOLUTE FORCE. Poor correlation exists if the larger size grains P, Q, T, U are included. However, the remaining lots show much better correlation, and whether the result always occurs by omitting reference firings is conjecture.

Figure 42: "IMPULSE". Poor correlation exists for zone 7 by using p-t area from 10 to 90% of peak pressure, with some improvement for zone 5. Practically the same plot occurred for 25 to 75% of peak closed bomb pressure.

Some trends between closed bomb and ballistics indicated by various RQ and AQ approaches are illustrated in Figures 43 to 49.

The overall results are not too striking, but for the data used, show the favorable aspects of AQ and least squares fit of pressure data.

Figure 43: RQ (Rad RC, 8-20 kpsi, Δ p=4). This figure plots the mean values of Figure 37, and RQ is that calculated by MIL-STD. Poor clustering occurs around the 100% RQ region, where the lots were principally mixture and geometry changes.

Figure 44: RQ (9 point Cubic fit; 8-20 kpsi; Δ p=4). This has the same graphing as Figure 43, but the 9 point fit has the effect of stretching RQ at the high and low values.

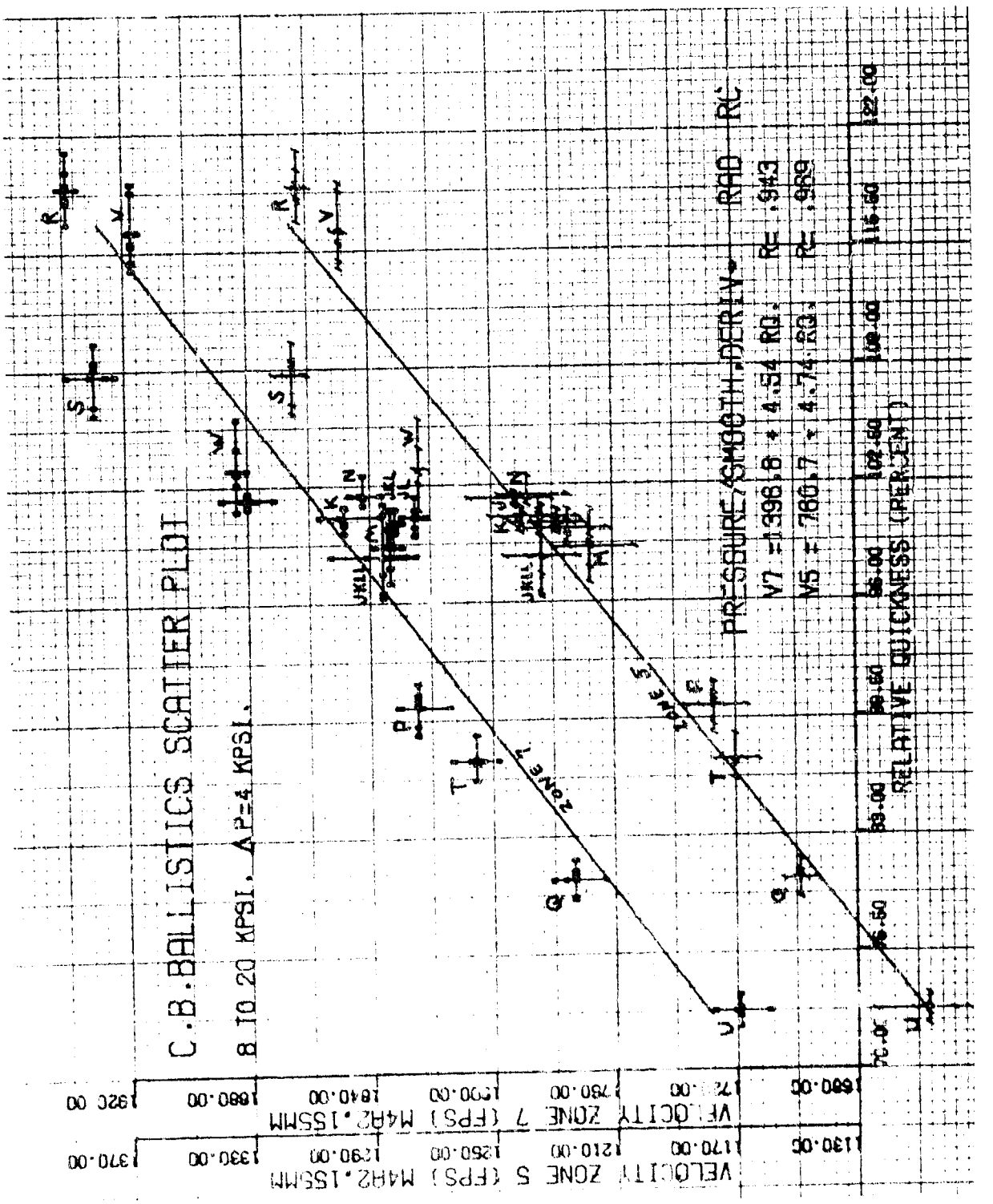
Figure 45: RQ (Rad RC; 4-28 kpsi, Δ p=2). This is similar to Figure 43, with little difference resulting by merely extending the pressure range.

Figure 46: RQ (9 point Cubic fit; 4-28; Δp=2). Again, just stretching occurs with a 9 point fit.

Figure 47: AQ (9 point Cubic fit; 8-20; Δ p=4). Stretching of data occurs. Use of RAD RC method in this region caused excess clustering in the central region.

Figure 48: AQ (Rad RC, 4-28 kpsi, Δ p=2). This pressure range with AQ causes better branching out of data.

Figure 49: AQ (9 point Cubic fit; 4-28 kpsi, Δ p=2). Results are similar to Figure 48, though the 9 point method places lot R further from a linear regression line. The plot is identical to Figure 38 except for a change in zone 7 scaling.



Figur 37 Scatter Plot, RQ

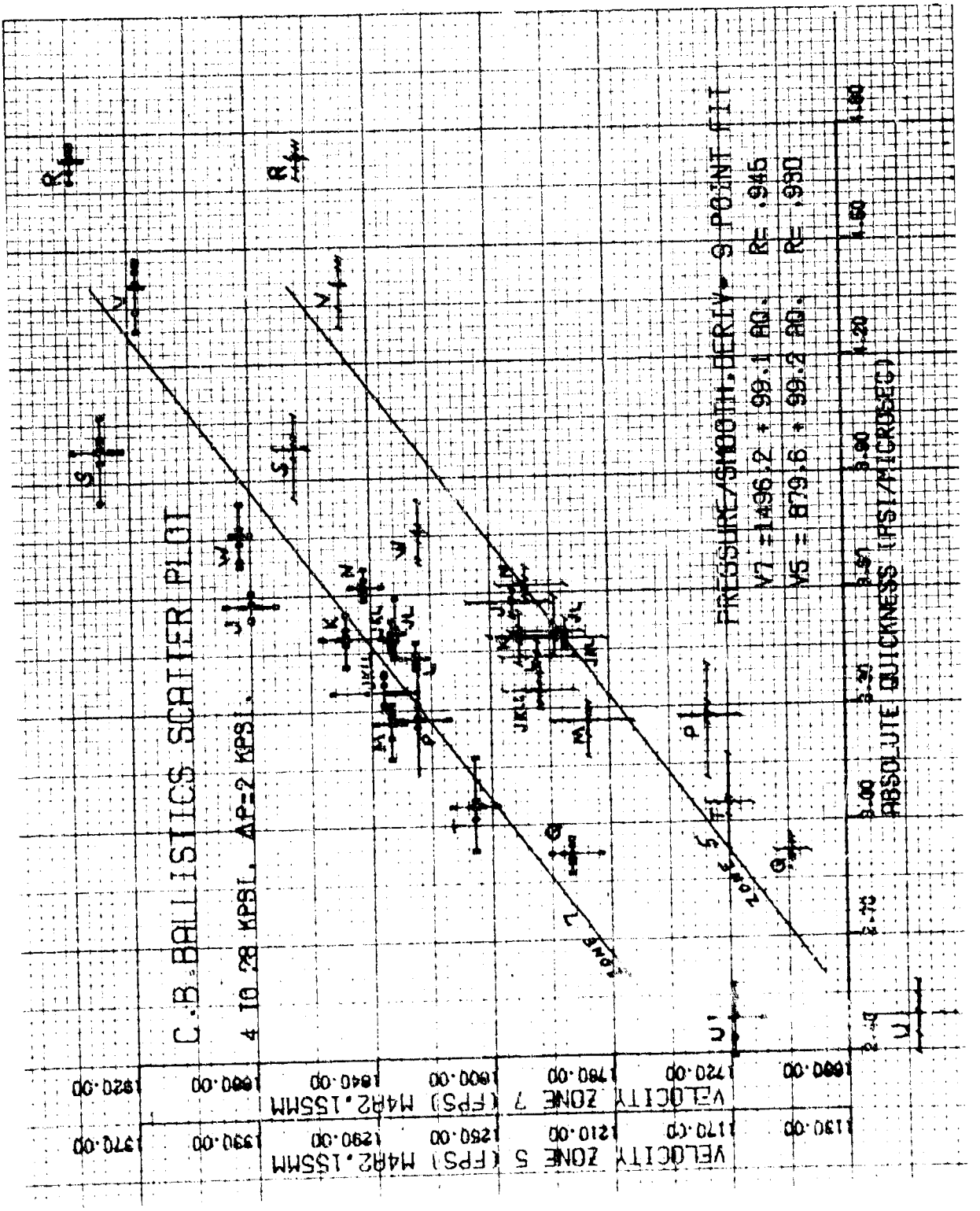


Figure 38 Scatter Plot, AQ

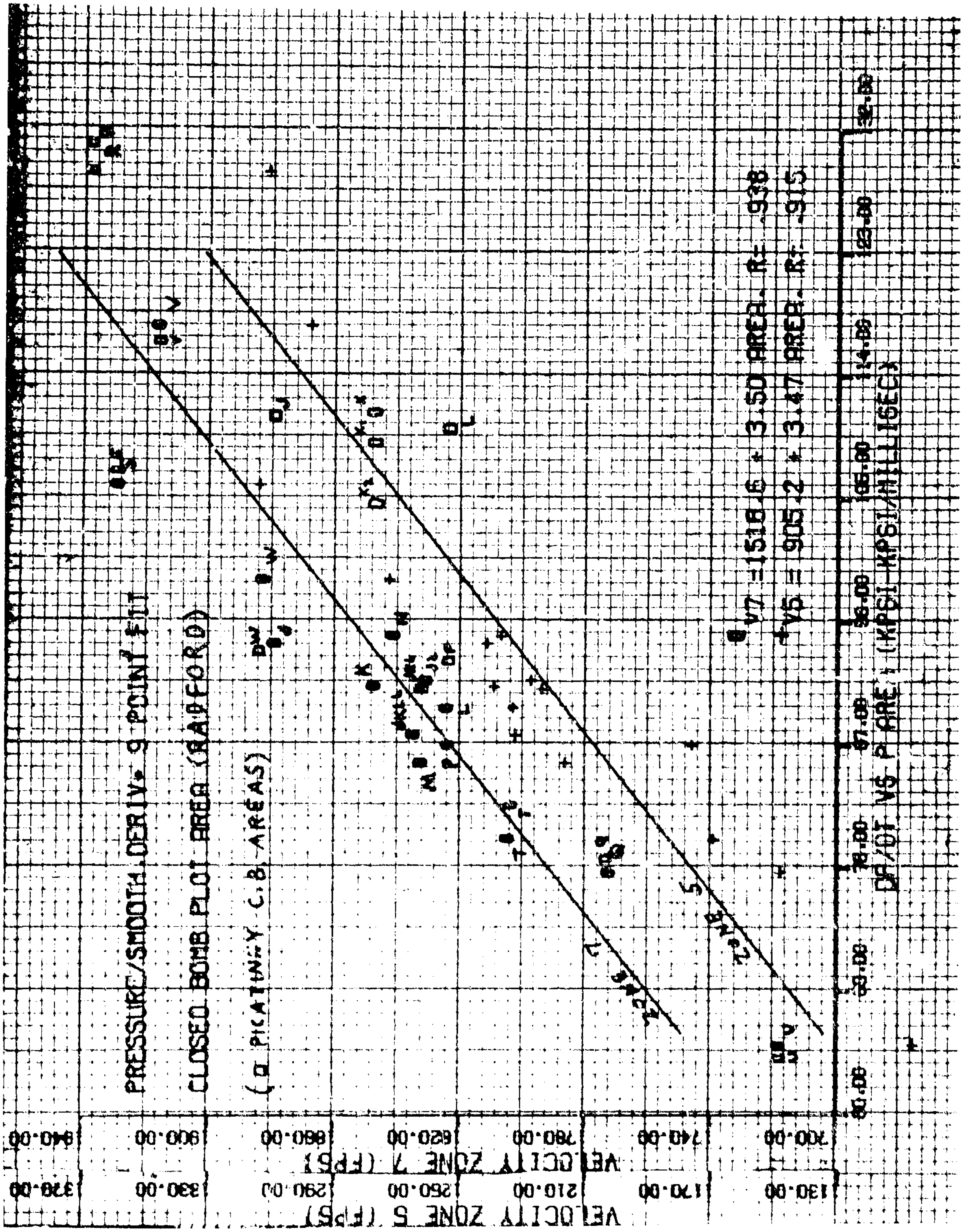


Figure 39 AREA Plot (9 Point)

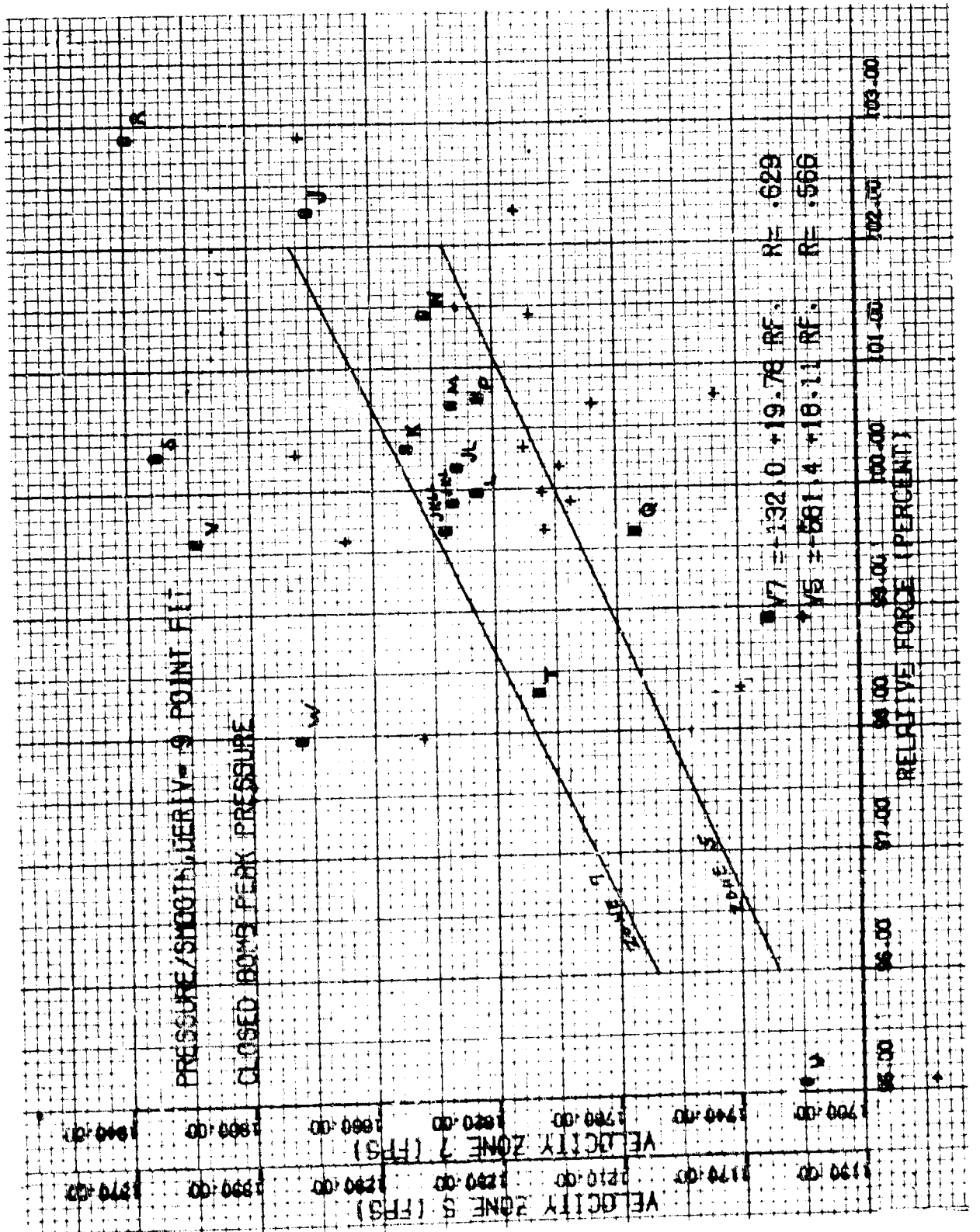


Figure 40 RF Plot (9 Point)

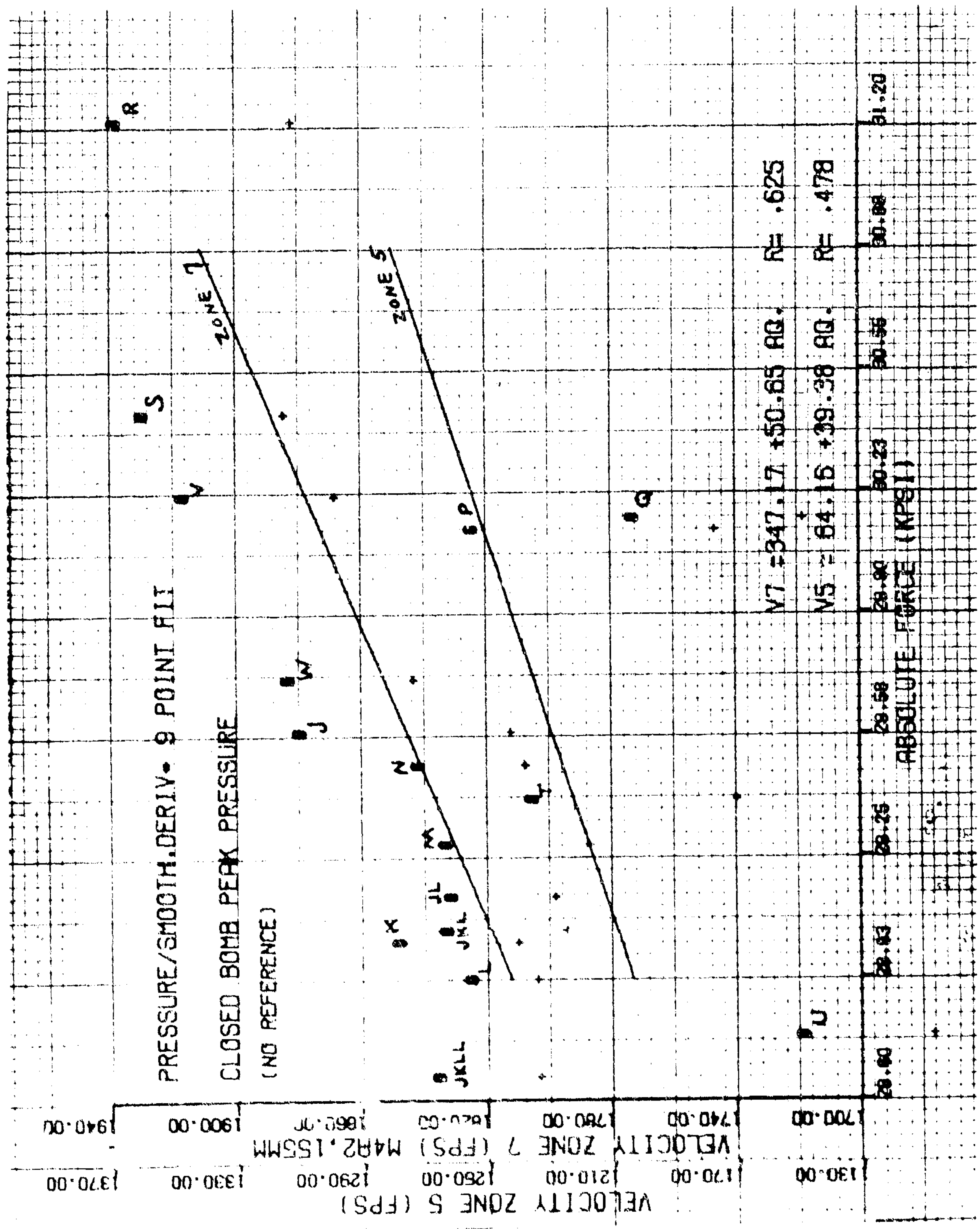


Figure 41 AF Plot (9 Point)

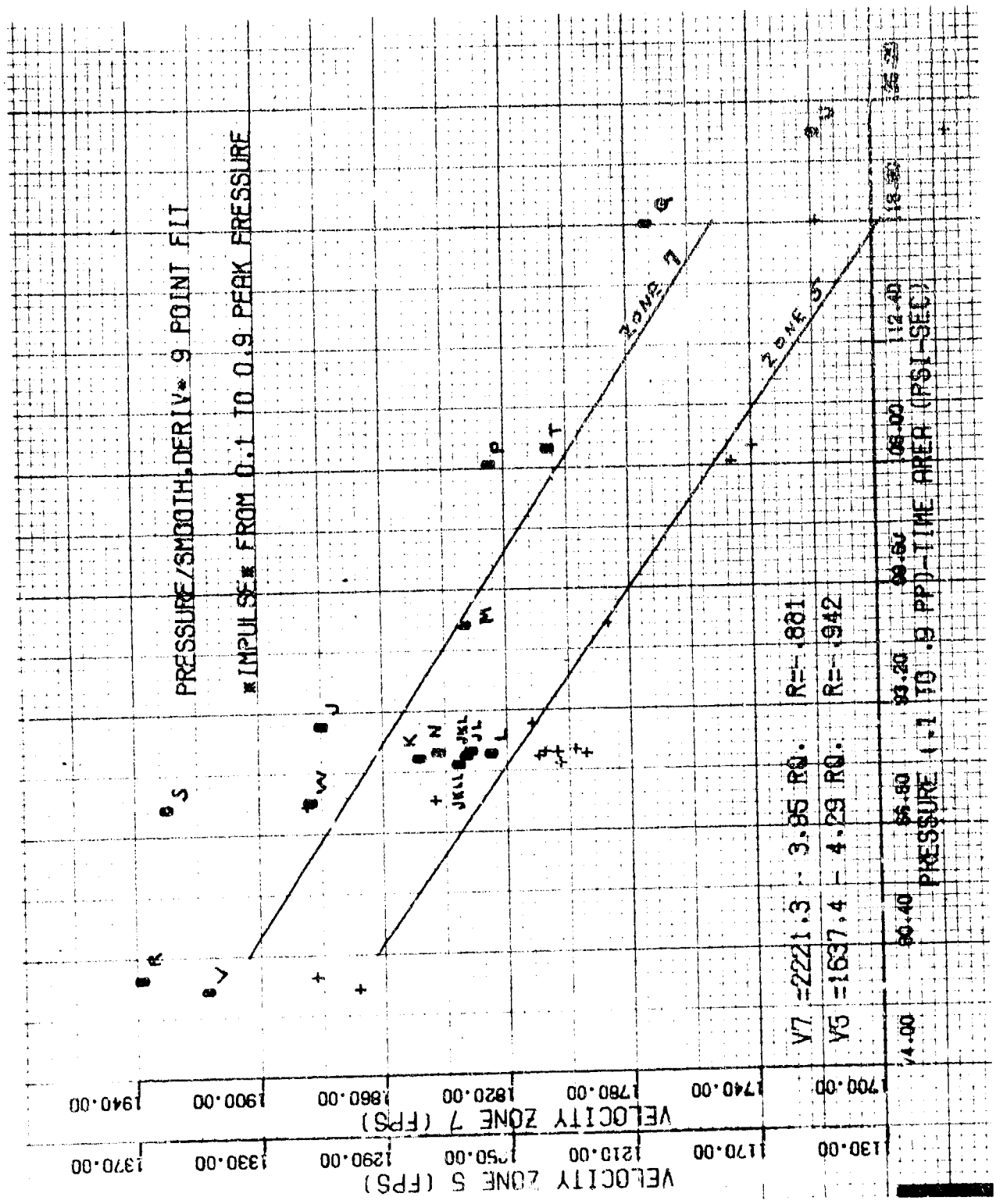


Figure 42 "Impulse" Plot (9 Point)

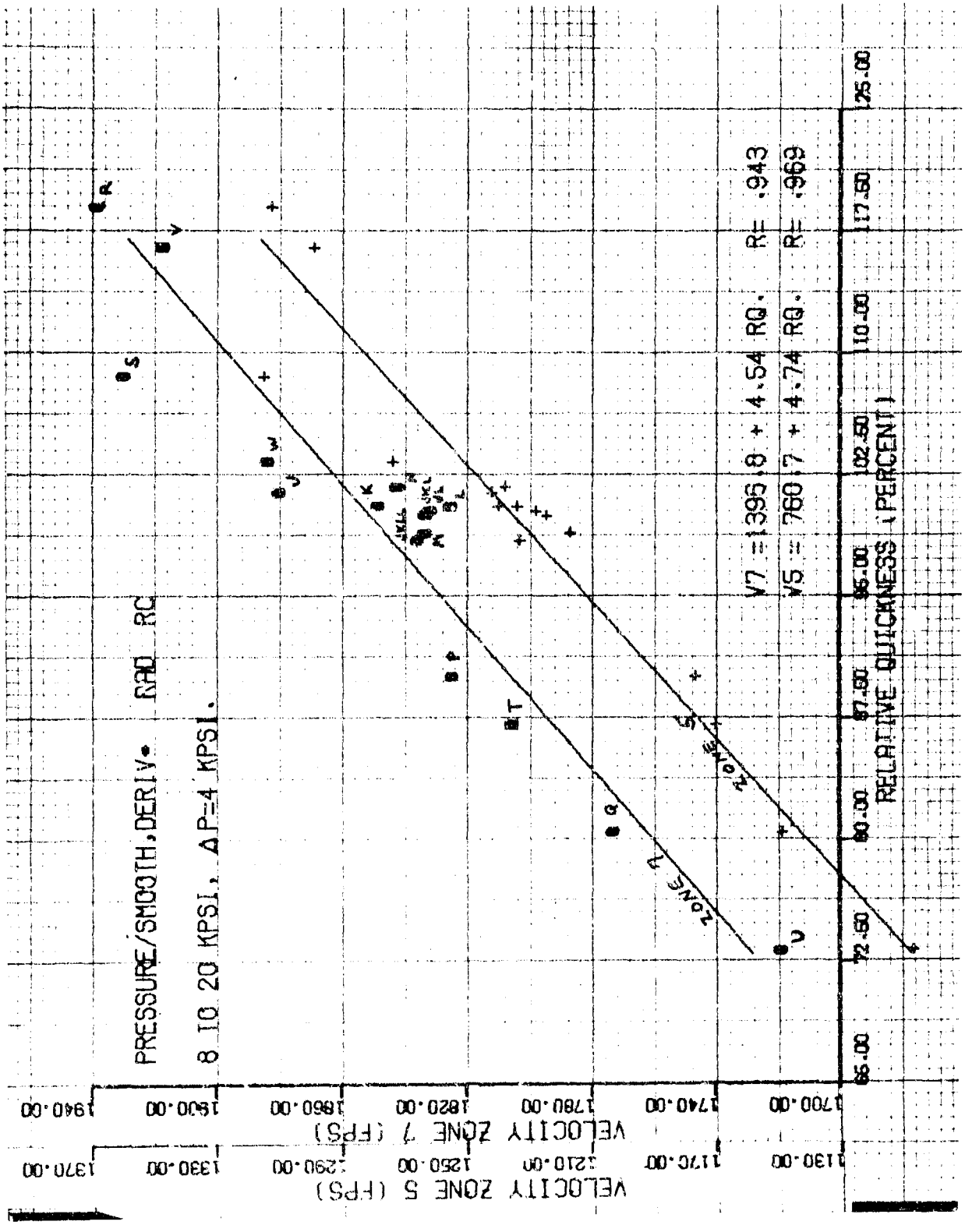


Figure 43 RQ Plot (RC, 8-20, 4)

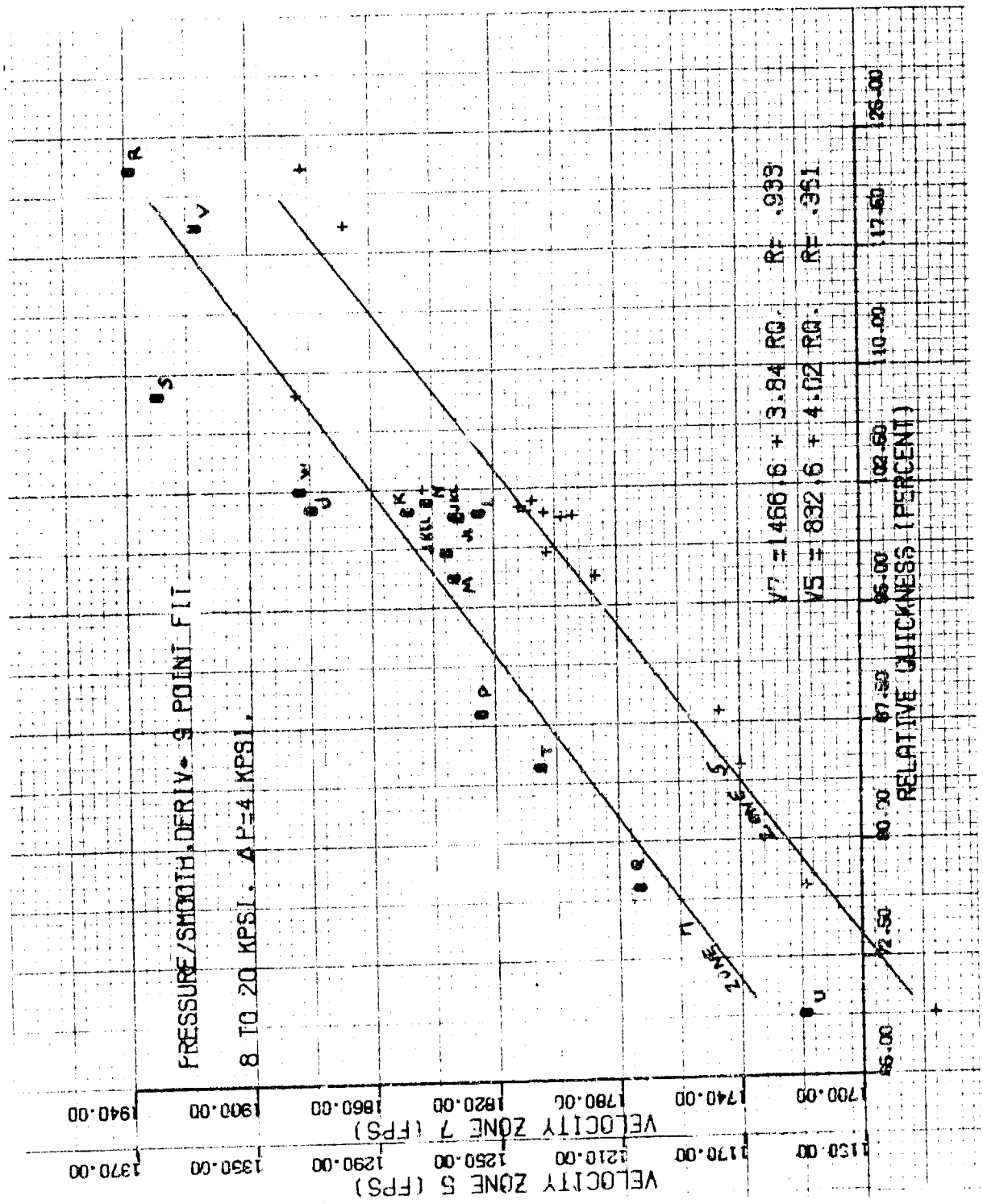


Figure 44 RQ Plot (9 PT, 8-20, 4)

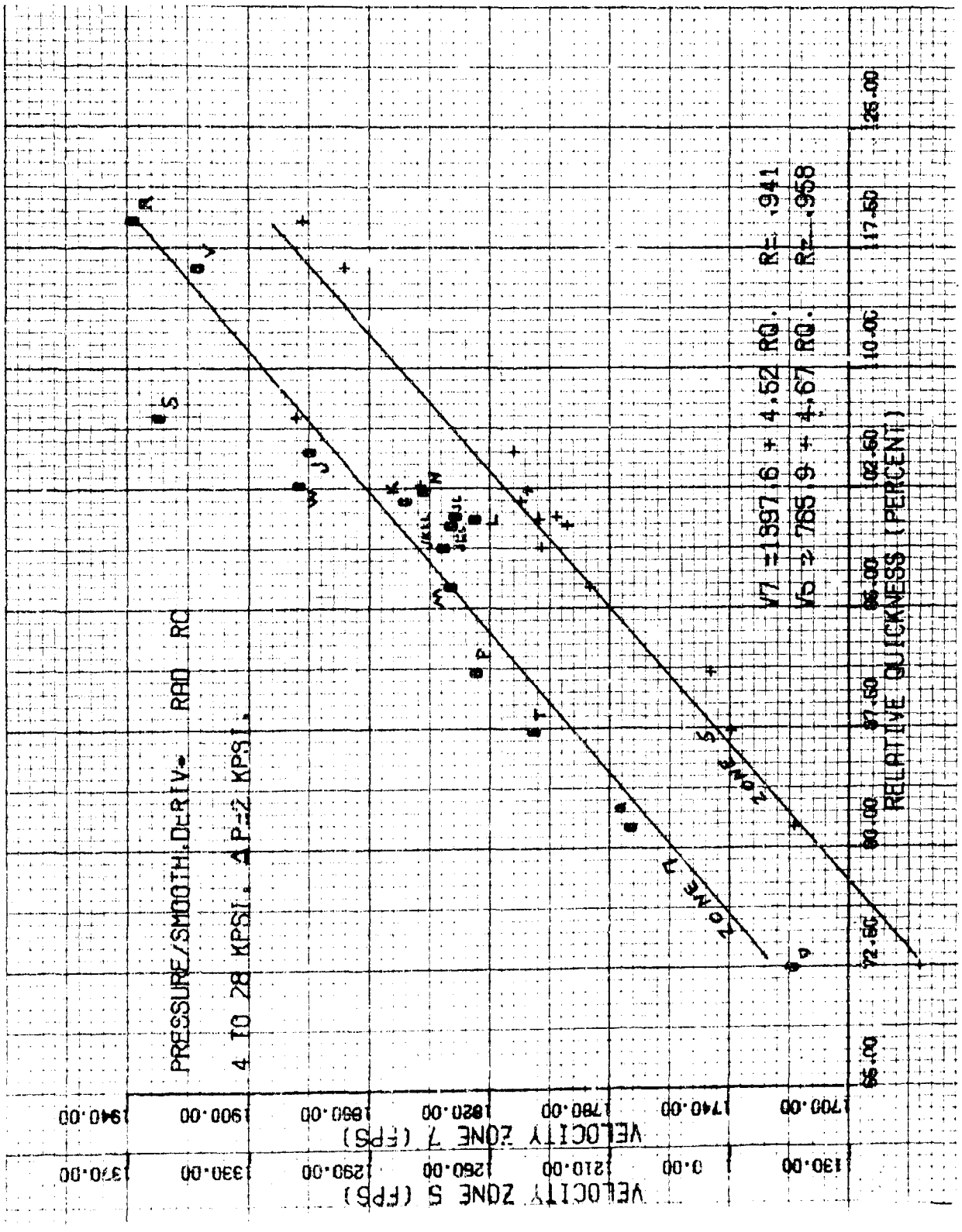


Figure 45 RQ Plot (RC, 4-28, 2)

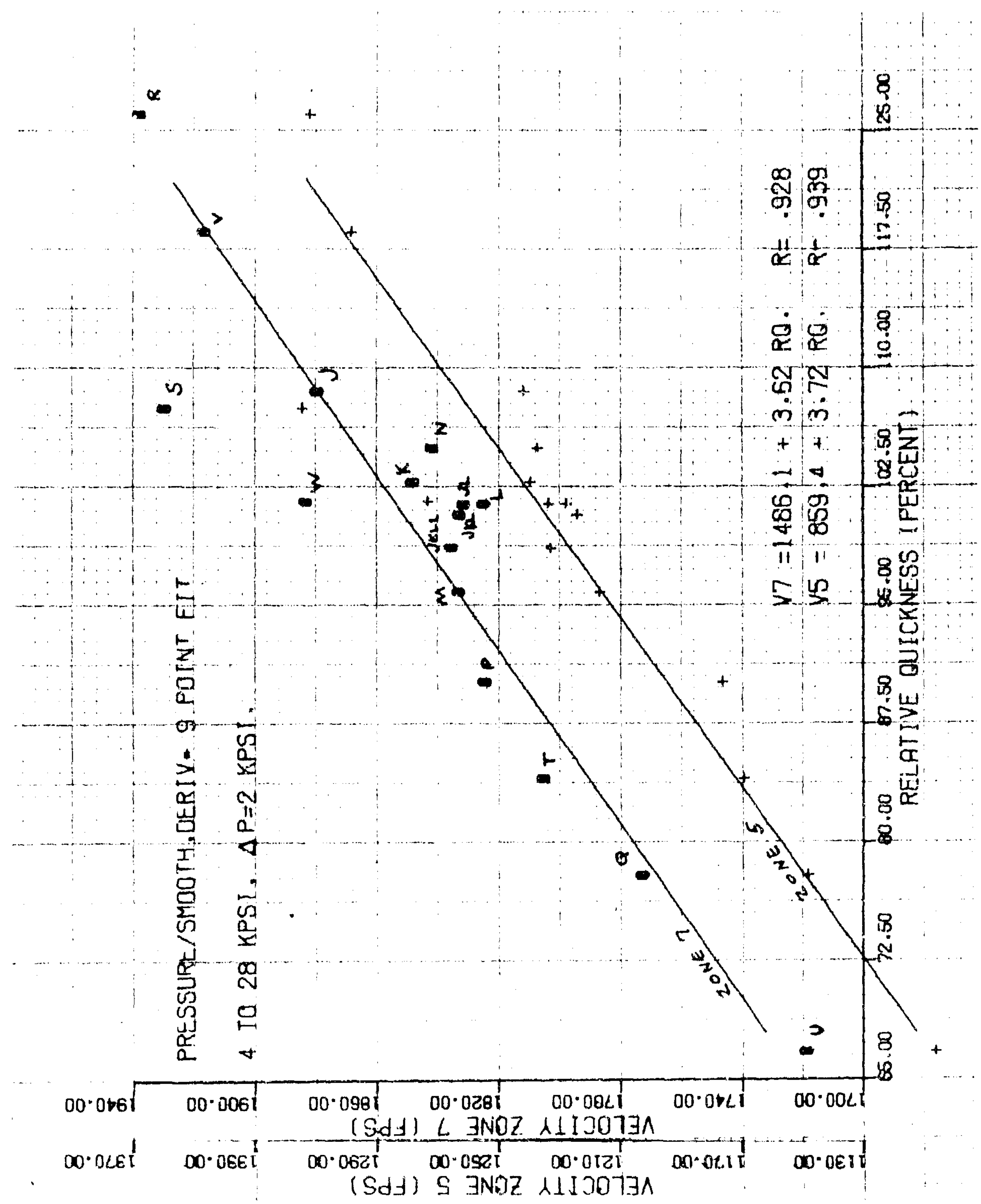


Figure 46 RQ Plot (9 PT, 4-28, 2)

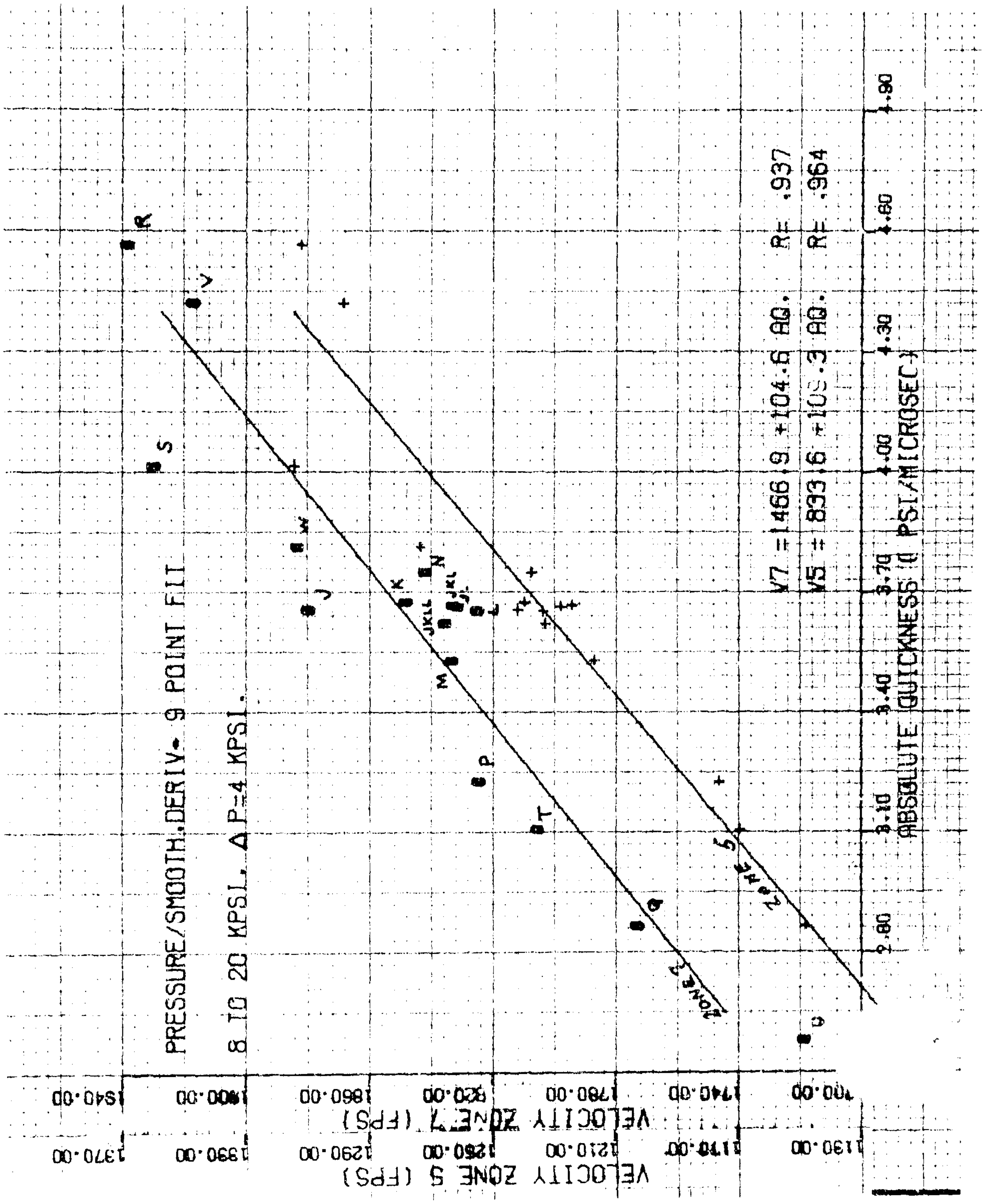


Figure 47 AQ Plot (9 PT, 8-20, 4)

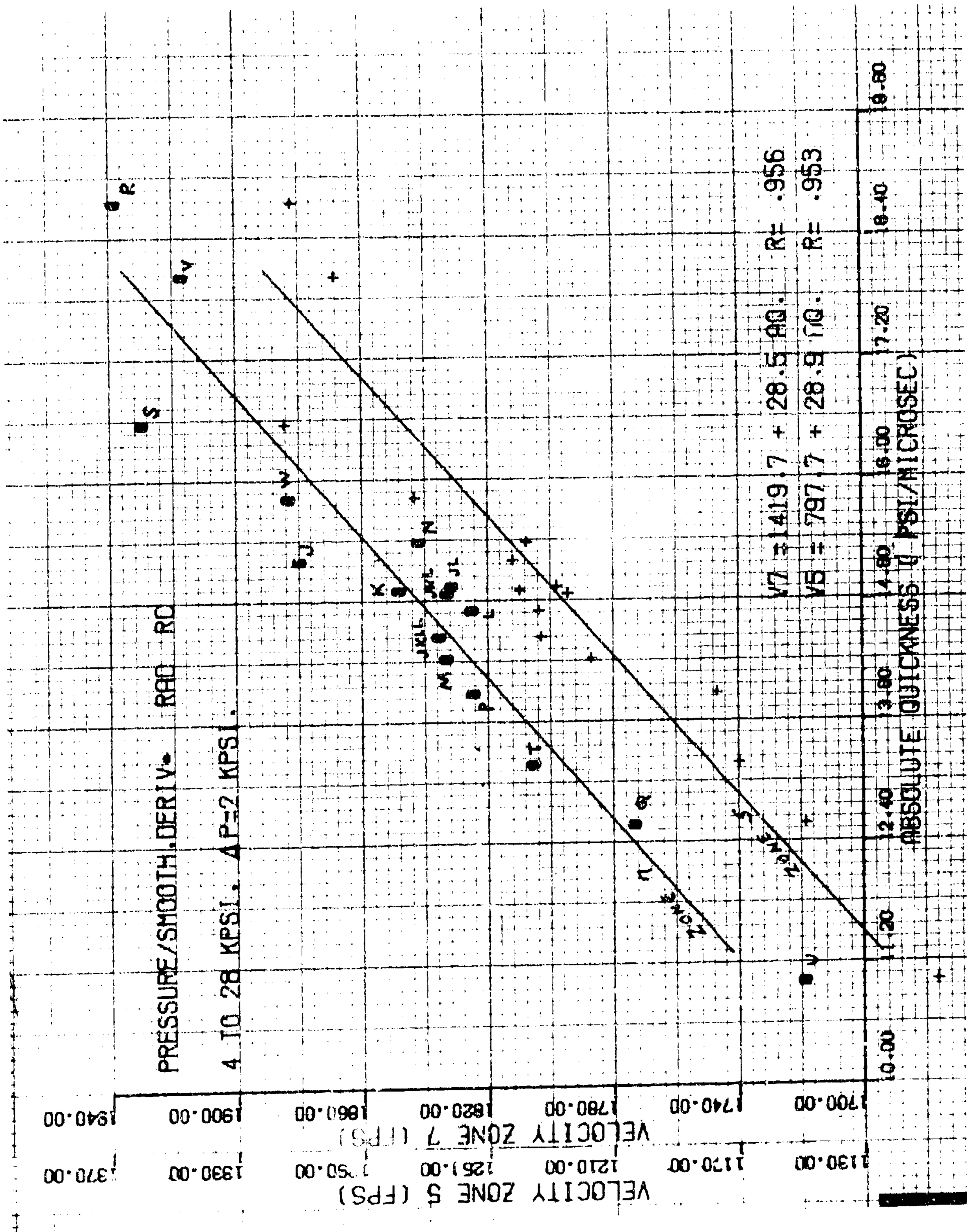


Figure 48 AQ Plot (RC, 4-28, 2)

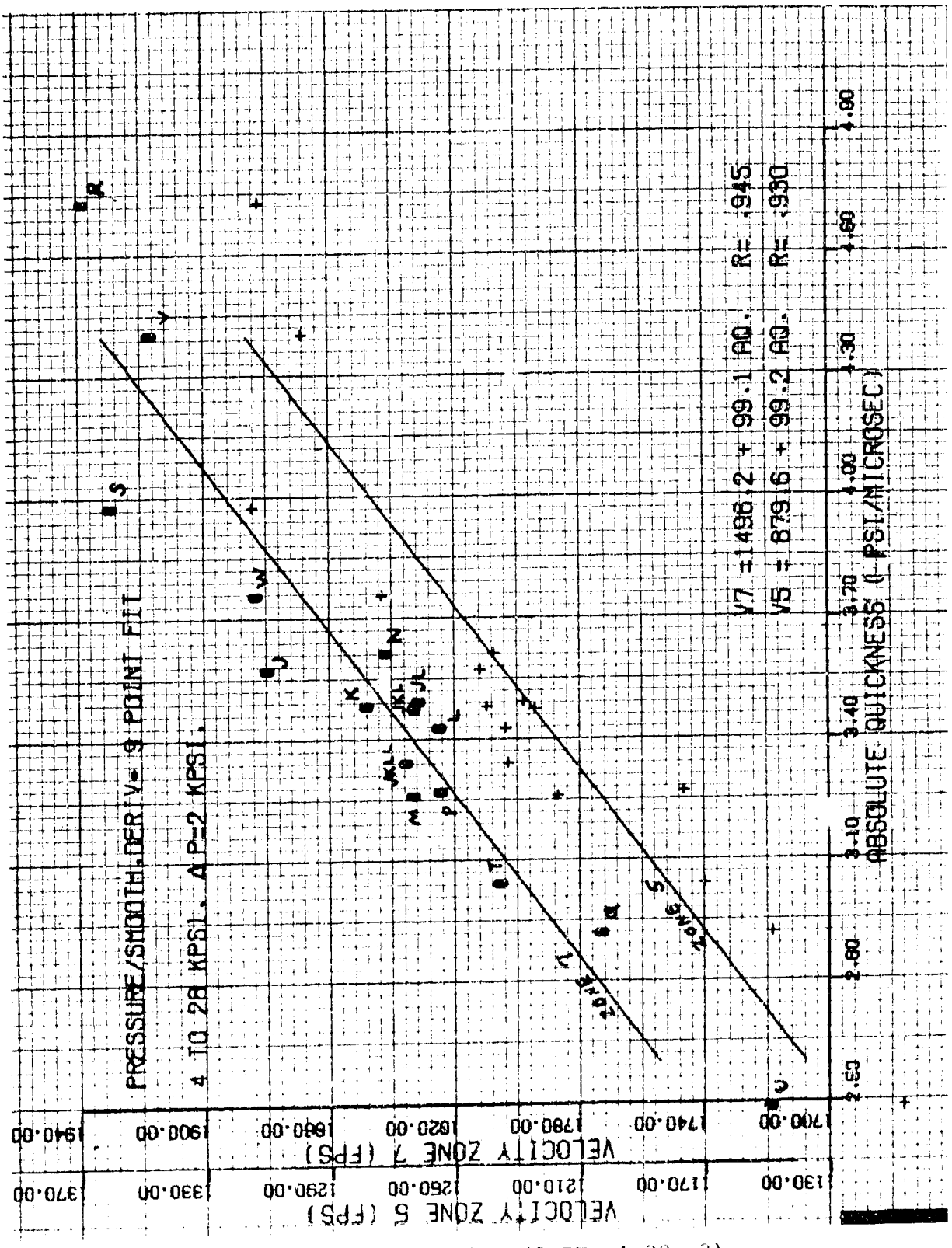


Figure 49 AQ Plot (9 PT, 4-28, 2)

C.2 Computer Printout Tables

In an attempt to condense the selected tables listed, Table 21 lists the linear correlation coefficient R for the various mean closed bomb derived values for various lots for:

1. Zone 5 and 7;
2. Using RAD RC and 9 point cubic least square fit;
3. Using all lots, R and V excluded, or mixture and geometry variation lots excluded.

It is not physically meaningful to just correlate closed bomb data (one loading density) to two different gun firing zones, but the statistical results are listed for information.

Coefficient values in excess of 0.98 are circled. A detailed definition of various terms in these tables has already been given. A table titled: AQ (RC, 4-28, 2) means ballistic correlation with AQ (absolute quickness) when the Radford RC method is used on the raw data, and dp/dt values are taken from 4 to 28 kpsi at each 2 kpsi increment for calculating the AQ.

The tables are self-explanatory. The 8 columns refer to values for the six separate firings, and to the mean and standard deviation. Lot letters in parenthesis refer to the reference lot fired for these test lots. The use of the linear regression equations is given in Section C.1.

Another indication of variation introduced by use of reference propellant closed bomb firings is shown in Tables 35, 36, 47, 48 where each of the 8 sets of reference firings of 6 firings each were vied with each other in an RQ calculation, and displayed in a 6x6 matrix for each set. This RQ calculation is:

$$RQ_{i,k} = \frac{100}{N} \sum_{j=1}^{N} \frac{R_{i,j}}{R_{k,j}}$$

where i = k = M = 6 sets of firings in this case.
N = 4, 14, 12, or 22 data points depending on the method of RQ calculation used in this report.

In Table 35 this shows a variation up to 3% in RQ due to variability within some sets of 6 reference firings. When a larger pressure range is used for RQ (Table 47) this variation goes up to about 5% (about 10% for LL-JKLL).

The last set of Tables (55 to 63) list results for Picatinny closed bomb firings. Only three firings of each lot (none of M, N, LL, or mixture lots) were done, and some mechanical difficulty in the pressure gage existed in regard to firings of lots J, K, L.

Despite this, to obtain some indication of ballistic correspondence, lot K was used as reference for J and L firings, and K1 for lots R, S, V, W and K2 for lots P, Q, T, U. (K1 and K2 are lot K fired with troublesome free gage). It is understood that one-to-one correspondence with Radford results is not expected. The original data on which all these results are based is listed in Appendix B.

Table 21

Correlation Coefficients for Radford Closed Bomb-Ballistic data

Pressure Range		Zone	ALL LOTS RC	ALL LOTS 9C	EXCLUDE R,V RC	EXCLUDE R,V 9C	ONLY JKLPQSTUW RC	ONLY JKLPQSTUW 9C
All	AREA	7	.946	.938	.972	.967	.989	.988
(DP/DT, P)		5	.919	.915	.960	.965	.971	.977
8-20	AQ	7	.944	.937	.919	.910	.963	.952
Δ P=4		5	969	.964	.973	.973	.990	.987
	RQ	7	943	.933	.915	.899	.952	.941
		5	.969	.961	.966	.957	.980	.972
8-20	AQ	7	.944	.937	.918	.910	.964	.956
Δ P=1		5	.968	.964	.970	.971	.990	.988
	RQ	7	.941	.934	.912	.901	.953	.944
		5	.967	.962	.963	.958	.978	.973
4-28	AQ	7	.956	.945	.955	.960	.981	.985
Δ P=2		5	.953	.930	.975	.970	.985	.983
	RQ	7	.941	.928	.912	.890	.945	.928
		5	.958	.939	.949	.922	.957	.932
4-28	AQ	7	.954	.945	.949	.957	.977	.983
Δ P=1		5	.958	.935	.978	.973	.987	.985
	RQ	7	.941	.929	.912	.892	.946	.930
		5	.961	.944	.954	.930	.963	.939
	AF	7	.625	.625	.408	.408	.485	.485
		5	.478	.478	.215	.215	.332	.332
	RF	7	.626	.629	.602	.604	.630	.631
		5	.564	.566	.527	.528	.524	.523
PT AREA		7	-.889	-.881	-.848	-.839	-.903	-.900
(.1-.9 PP)		5	-.944	-.942	-.925	-.922	-.945	-.946

TABLE 22. RADFORD REPORTED RQ. (IBM FILTERED)

	1	2	3	4	5	6	AV	SD
J	101.31	101.59	101.87	101.89	101.19	102.06	101.65	.35
K	100.37	101.20	101.23	101.20	99.77	100.22	100.66	.63
L	100.79	99.58	101.77	101.00	100.06	100.60	100.63	.76
JL	99.72	100.00	100.15	101.07	99.83	101.04	100.30	.60
JKL	99.23	99.79	100.36	99.59	99.81	101.07	99.98	.65
JKLL	101.34	96.40	97.51	98.35	96.20	100.77	98.43	2.19
M	96.96	99.52	99.22	101.05	97.82	99.08	98.94	1.42
N	101.31	102.94	101.79	101.70	101.67	101.67	101.85	.56
P	89.08	90.80	90.50	91.43	90.23	88.56	90.10	1.08
Q	80.76	79.43	81.60	81.00	80.70	79.54	80.51	.85
R	119.17	119.92	118.42	117.04	118.23	121.01	118.96	1.39
S	109.41	109.03	109.31	106.97	106.45	110.44	108.60	1.55
T	87.08	86.94	87.21	88.54	86.03	86.97	87.13	.81
U	72.89	72.30	73.23	74.06	73.32	73.37	73.19	.58
V	114.93	115.80	115.90	118.75	119.19	114.44	116.50	1.99
W	102.55	103.09	101.05	104.51	106.10	102.50	103.30	1.77
LL	99.18	96.22	96.10	97.13	95.94	99.81	97.40	1.69

TABLE 23. RADFORD REPORTED RQ. (IBL POLAROID)

	1	2	3	4	5	6	AV	SD
J	100.83	101.40	100.87	101.63	100.00	101.03	100.96	.56
K	99.83	100.56	100.79	102.26	99.92	100.26	100.60	.89
L	100.28	100.42	100.63	101.07	99.97	99.86	100.37	.44
JL	99.45	99.45	99.88	101.21	99.88	100.99	100.14	.77
JKL	99.88	99.88	99.68	100.06	99.65	100.56	99.95	.33
JKLL	100.74	97.32	98.51	98.51	96.48	99.86	98.57	1.57
M	98.06	99.54	99.75	100.43	98.79	100.51	99.51	.95
N	101.31	102.82	102.05	101.35	101.89	101.64	101.84	.56
P	89.12	90.64	90.49	91.29	90.69	89.48	90.28	.82
Q	81.83	80.57	82.31	82.07	81.15	80.57	81.42	.76
R	118.48	118.55	117.60	116.25	116.47	119.22	117.76	1.20
S	109.24	108.70	109.21	107.24	105.89	110.60	108.48	1.67
T	87.55	87.54	88.18	88.01	87.18	88.19	87.78	.41
U	74.17	73.70	73.70	74.68	74.48	74.81	74.26	.48
V	113.69	114.87	113.27	116.93	117.26	114.19	115.04	1.69
W	101.06	102.88	100.84	103.36	105.28	102.88	102.72	1.63
LL	99.26	96.49	96.18	97.47	96.07	99.43	97.48	1.53

Table 24 Radford Reported RF (SY7)

RELATIVE FORCE

	1	2	3	4	5	6	AV	SD
J	102.99	102.58	102.56	101.31	101.74	102.50	102.28	.62
K	100.96	100.51	100.52	99.69	99.69	100.69	100.34	.53
L	100.99	99.98	99.52	99.89	99.50	99.97	99.97	.54
JL	100.45	99.79	99.68	100.93	99.92	100.32	100.18	.47
JKL	100.86	99.66	98.74	99.56	99.75	100.81	99.89	.81
JKLL	100.45	99.59	99.28	99.86	99.42	99.36	99.66	.44
M	100.60	101.43	100.03	100.40	100.37	101.34	100.69	.57
N	101.91	101.78	100.30	100.84	102.11	101.63	101.43	.70
P	99.98	101.59	100.51	100.91	99.67	101.87	100.75	.87
Q	99.82	99.77	98.60	100.14	99.70	99.79	99.64	.53
R	102.19	103.42	102.69	102.53	102.09	104.43	102.89	.89
S	99.29	101.13	99.81	100.30	98.90	102.37	100.30	1.28
T	98.27	99.32	98.33	97.87	97.64	98.55	98.33	.59
U	94.30	96.03	94.15	95.62	94.16	96.24	95.08	.98
V	99.58	99.40	98.45	99.16	101.56	99.40	99.59	1.04
W	98.85	97.54	97.07	96.85	100.03	97.52	97.97	1.22
LL	99.51	98.52	97.61	98.35	99.11	99.04	98.69	.67

VEL7 = -131.972 + 19.7805 X. R= .629 ALL LOTS.
VEL7 = 108.444 + 17.2888 X. R= .604 EXCLUDE LOTS R,V.
VEL7 = 1426.008 + 4.2093 X. R= .146 EXCLUDE LOTS R,V,Q,U.
VEL7 = 1912.823 + -.5855 X. R=-.020 EXCLUDE LOTS R,V,Q,U,P,T.
VEL7 = -86.912 + 19.3029 X. R= .631 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL7 = -7187.858 +1961.7585 X. R= .630 ALL LOTS LOG FIT.
VEL5 = -581.370 + 18.1111 X. R= .566 ALL LOTS.
VEL5 = -378.083 + 15.9969 X. R= .528 EXCLUDE LOTS R,V.
VEL5 = 1069.149 + 1.6328 X. R= .051 EXCLUDE LOTS R,V,Q,U.
VEL5 = 1856.803 + -6.1060 X. R=-.239 EXCLUDE LOTS R,V,Q,U,P,T.
VEL5 = -449.505 + 16.7120 X. R= .523 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL5 = -7055.392 +1799.1512 X. R= .568 ALL LOTS LOG FIT.

Table 25 Radford Reported RF (IBL Polaroid)

RADFORD REPORTED RF. (IBL-POLAROID)

	1	2	3	4	5	6	AV	SD
J	102.76	102.72	102.05	102.01	102.05	102.74	102.39	.39
K	100.66	100.00	100.70	99.29	99.35	101.37	100.23	.83
L	101.38	100.00	99.35	100.00	99.35	100.71	100.13	.79
JL	100.71	100.00	100.00	100.70	100.00	100.65	100.34	.38
JKL	101.37	100.00	99.30	99.35	100.00	101.36	100.23	.93
JKLL	101.38	99.29	100.00	100.00	99.35	99.35	99.89	.80
M	100.70	101.35	100.00	100.00	100.00	101.35	100.57	.66
N	102.05	102.05	100.69	100.69	101.34	102.05	101.48	.67
P	100.00	101.34	100.64	100.69	100.00	101.32	100.67	.60
Q	99.31	100.00	98.69	100.00	100.00	100.00	99.67	.55
R	102.63	103.97	102.61	103.32	102.63	104.00	103.19	.67
S	99.37	100.64	100.00	100.00	99.37	102.03	100.24	1.00
T	98.00	98.66	98.66	98.03	98.03	97.99	98.23	.33
U	93.58	96.00	94.09	96.03	94.70	96.03	95.04	1.15
V	98.67	99.37	99.37	99.37	101.33	99.32	99.57	.90
W	99.36	98.05	97.37	96.74	100.00	97.39	98.15	1.27
LL	100.00	98.64	97.93	98.64	99.35	99.35	98.98	.73

TABLE 26. PEAK PRESSURE (KPSI) (9 pt)

	1	2	3	4	5	6	AV	SD
J	29.40	29.66	29.82	29.43	29.63	29.56	29.58	.16
K	28.82	29.06	29.23	28.96	29.03	29.04	29.02	.14
L	28.83	28.91	28.94	29.02	28.97	28.83	28.92	.08
JL	28.94	29.08	29.26	29.40	29.09	29.06	29.14	.16
JKL	29.06	29.04	28.98	29.00	29.04	29.20	29.05	.08
JKLL	28.54	28.59	28.60	28.75	28.72	28.75	28.66	.09
M	29.07	29.34	29.29	29.39	29.19	29.38	29.28	.13
N	29.45	29.44	29.37	29.52	29.70	29.46	29.49	.11
P	29.58	30.19	30.05	30.25	29.96	30.11	30.12	.37
Q	30.03	30.00	30.14	30.31	30.23	30.17	30.15	.12
R	31.14	31.21	31.40	31.22	31.07	31.23	31.21	.11
S	30.26	30.52	30.52	30.54	30.10	30.61	30.43	.20
T	29.08	29.52	29.40	29.34	29.35	29.71	29.40	.21
U	28.37	28.88	28.78	28.94	28.55	29.10	28.77	.27
V	29.90	30.29	30.05	30.18	30.41	30.44	30.21	.21
W	29.68	29.72	29.62	29.48	29.95	29.86	29.72	.17
LL	28.27	28.28	28.12	28.31	28.63	28.66	28.38	.22
(J-K-L)	28.54	28.92	29.08	29.05	29.12	28.84	28.93	.22
(JL-JKL)	28.81	29.14	29.35	29.13	29.11	28.96	29.08	.18
(LL-JKLL)	28.41	28.70	28.81	28.79	28.89	28.94	28.76	.19
(M-N)	28.89	28.93	29.28	29.28	29.08	28.99	29.08	.17
(P-T)	29.59	29.72	29.90	29.98	30.06	30.15	29.90	.21
(Q-U)	30.09	30.07	30.57	30.27	30.32	30.24	30.26	.18
(R-S)	30.48	30.18	30.58	30.45	30.43	29.90	30.34	.25
(V-W)	30.02	30.47	30.52	30.44	29.94	30.62	30.34	.28
(6-HEX)	28.65	30.48	30.07	30.10	30.34	30.20	0.00	0.00

Table 27 AREA DP/DT vs P (PC)

AREA DP/DT VS P CURVE(KPSI-KPSI)/(MS)

	1	2	3	4	5	6	AV	SD
J	398.70	407.52	407.97	399.87	405.07	404.83	403.99	3.88
K	381.52	391.35	395.20	386.72	387.78	389.57	388.69	4.61
L	380.39	380.21	383.30	387.01	383.68	381.34	382.74	2.61
JL	385.03	389.53	393.59	401.57	388.90	390.03	391.44	5.66
JKL	389.55	386.92	387.54	385.06	387.11	394.40	388.43	3.26
JKLL	372.64	370.58	372.01	378.73	376.41	378.95	374.89	3.62
M	364.54	378.27	376.60	379.89	369.75	376.90	374.33	5.91
N	405.38	410.51	404.48	406.94	402.60	409.27	406.53	2.98
P	355.72	378.21	375.91	380.61	372.61	395.13	376.37	12.76
Q	335.78	332.57	345.08	343.05	343.58	337.61	339.61	5.01
R	530.93	535.85	541.19	539.17	527.17	539.49	535.63	5.52
S	449.01	454.83	458.88	457.26	435.94	464.43	453.39	9.93
T	335.09	348.58	348.47	349.90	343.53	362.59	348.03	8.98
U	275.10	284.84	285.93	290.80	280.37	294.75	285.30	7.05
V	475.45	495.15	482.75	490.82	502.19	501.49	491.31	10.60
W	419.55	423.81	413.48	412.53	432.18	431.09	422.11	8.46
LL	352.27	359.62	351.30	359.50	373.81	373.53	361.67	9.93
(J-K-L)	367.60	381.86	381.07	380.49	387.74	377.89	379.44	6.65
(JL-JKL)	377.31	390.54	394.15	388.35	388.31	379.36	386.33	6.58
(LL-JKLL)	356.26	381.37	381.71	381.72	392.16	380.26	378.92	11.93
(M-N)	386.64	389.49	397.76	396.18	394.76	393.25	393.01	4.21
(P-T)	392.42	401.10	411.60	413.53	415.06	421.36	409.18	10.53
(Q-U)	417.18	422.72	434.59	425.12	430.33	426.73	426.11	6.04
(R-S)	429.13	421.80	436.62	433.89	431.21	412.64	427.55	8.87
(V-W)	417.16	434.87	435.81	424.44	410.05	441.10	427.24	12.07
(6-HEX)	280.25	583.30	414.54	424.97	431.75	429.46	0.00	0.00

VEL7	=	1484.167	+ .9070	X.	R= .946	ALL LOTS.
VEL7	=	1369.449	+ 1.2164	X.	R= .972	EXCLUDE LOTS R,V.
VEL7	=	1382.771	+ 1.1840	X.	R= .933	EXCLUDE LOTS R,V,Q,U.
VEL7	=	1348.755	+ 1.2677	X.	R= .923	EXCLUDE LOTS R,V,Q,U,P,T.
VEL7	=	1353.384	+ 1.2667	X.	R= .989	INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL7	=	-383.379	+ 372.8921	X.	R= .963	ALL LOTS LOG FIT.
VEL5	=	872.613	+ .8953	X.	R= .919	ALL LOTS.
VEL5	=	733.119	+ 1.2713	X.	R= .960	EXCLUDE LOTS R,V.
VEL5	=	719.746	+ 1.3066	X.	R= .920	EXCLUDE LOTS R,V,Q,U.
VEL5	=	798.790	+ 1.1181	X.	R= .940	EXCLUDE LOTS R,V,Q,U,P,T.
VEL5	=	721.599	+ 1.2975	X.	R= .971	INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL5	=	-981.376	+ 369.8385	X.	R= .940	ALL LOTS LOG FIT.
PP 7	=	-8.751	+ .1150	X.	R= .932	ALL LOTS.
PP 7	=	-15.078	+ .1320	X.	R= .893	EXCLUDE LOTS R,V.
PP 7	=	-32.561	+ .1759	X.	R= .695	EXCLUDE LOTS R,V,Q,U.
PP 7	=	-44.888	+ .2061	X.	R= .920	EXCLUDE LOTS R,V,Q,U,P,T.
PP 7	=	-17.526	+ .1412	X.	R= .943	INCLUDE LOTS J,K,L,P,Q,S,T,U,W
PP 7	=	-238.018	+ 46.0189	X.	R= .924	ALL LOTS LOG FIT.
PP 5	=	.180	+ .0335	X.	R= .926	ALL LOTS.
PP 5	=	-3.037	+ .0422	X.	R= .916	EXCLUDE LOTS R,V.
PP 5	=	-8.292	+ .0554	X.	R= .923	EXCLUDE LOTS R,V,Q,U.
PP 5	=	-8.552	+ .0561	X.	R= .921	EXCLUDE LOTS R,V,Q,U,P,T.
PP 5	=	-3.654	+ .0441	X.	R= .936	INCLUDE LOTS J,K,L,P,Q,S,T,U,W
PP 5	=	-67.312	+ 13.5247	X.	R= .925	ALL LOTS LOG FIT.

Table 28 AREA DP/DT vs P (9 C)

AREA DP/DT VS P CURVE(KPSI-PSI)/(MS)

	1	2	3	4	5	6	AV	SD
J	93.19	95.40	95.54	93.57	94.74	94.71	94.52	.95
K	89.53	92.04	93.07	90.89	91.18	91.57	91.38	1.18
L	89.13	89.15	90.09	90.82	89.96	89.54	89.78	.65
JL	90.26	91.32	92.32	94.29	91.17	91.58	91.82	1.38
JKL	91.61	90.72	91.03	90.38	90.79	92.64	91.19	.82
JKLL	87.13	86.71	87.11	88.84	88.28	88.94	87.83	.97
M	83.45	86.70	86.35	87.08	84.66	86.44	85.78	1.41
N	94.75	96.08	94.60	95.19	94.11	95.69	95.07	.73
P	82.10	87.48	87.01	88.01	86.24	91.63	87.08	3.07
Q	76.87	76.07	79.08	78.54	78.75	77.29	77.77	1.20
R	127.51	128.67	130.09	131.25	126.62	129.76	128.98	1.72
S	105.05	106.41	107.33	107.16	101.92	108.91	106.13	2.42
T	77.04	80.40	80.39	80.69	79.25	83.76	80.26	2.19
U	62.80	64.97	65.27	66.42	63.93	67.33	65.12	1.64
V	113.45	118.40	114.95	117.35	121.61	120.64	117.73	3.17
W	98.61	99.60	97.04	96.82	101.69	101.44	99.20	2.10
LL	82.17	84.13	82.03	84.11	87.69	87.67	84.63	2.53
(J-K-L)	85.71	89.42	89.20	88.96	90.81	88.36	88.74	1.69
(JL-JKL)	88.08	91.62	92.39	91.02	90.95	88.57	90.44	1.72
(LL-JKLL)	82.73	89.18	89.28	89.35	92.04	88.99	88.60	3.09
(M-N)	90.59	91.38	93.35	92.95	92.70	92.39	92.23	1.04
(P-T)	91.44	93.70	96.53	96.98	97.23	98.66	95.75	2.67
(Q-U)	97.79	99.23	102.14	99.84	101.11	100.20	100.05	1.51
(R-S)	100.58	99.01	102.57	101.86	101.27	96.72	100.34	2.15
(V-W)	97.77	102.21	102.46	99.57	96.10	103.66	100.29	2.97
(6-HEX)	63.89	137.31	96.86	99.78	101.38	101.14	0.00	0.00

VEL7 = 1518.610 + 3.5043 X. R= .938 ALL LOTS.
VEL7 = 1402.569 + 4.8488 X. R= .967 EXCLUDE LOTS R,V.
VEL7 = 1417.949 + 4.6866 X. R= .919 EXCLUDE LOTS R,V,Q,U.
VEL7 = 1376.316 + 5.1226 X. R= .906 EXCLUDE LOTS R,V,Q,U,P,T.
VEL7 = 1384.548 + 5.0891 X. R= .988 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL7 = 306.917 + 340.1255 X. R= .959 ALL LOTS LOG FIT.
VEL5 = 905.243 + 3.4734 X. R= .915 ALL LOTS.
VEL5 = 763.022 + 5.1208 X. R= .965 EXCLUDE LOTS R,V.
VEL5 = 746.638 + 5.3020 X. R= .929 EXCLUDE LOTS R,V,Q,U.
VEL5 = 816.491 + 4.5892 X. R= .937 EXCLUDE LOTS R,V,Q,U,P,T.
VEL5 = 750.048 + 5.2524 X. R= .977 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL5 = -304.625 + 339.0856 X. R= .940 ALL LOTS LOG FIT.
PP 7 = -4.492 + .4454 X. R= .926 ALL LOTS.
PP 7 = -11.342 + .5244 X. R= .886 EXCLUDE LOTS R,V.
PP 7 = -27.171 + .6944 X. R= .880 EXCLUDE LOTS R,V,Q,U.
PP 7 = -40.609 + .8352 X. R= .905 EXCLUDE LOTS R,V,Q,U,P,T.
PP 7 = -13.942 + .5660 X. R= .940 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
PP 7 = -152.944 + 42.0010 X. R= .920 ALL LOTS LOG FIT.
PP 5 = 1.426 + .1297 X. R= .920 ALL LOTS.
PP 5 = -1.903 + .1683 X. R= .912 EXCLUDE LOTS R,V.
PP 5 = -6.744 + .203 X. R= .913 EXCLUDE LOTS R,V,Q,U.
PP 5 = -7.285 + .2264 X. R= .902 EXCLUDE LOTS R,V,Q,U,P,T.
PP 5 = -2.598 + .1776 X. R= .937 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
PP 5 = -42.346 + 12.3520 X. R= .922 ALL LOTS LOG FIT.

Table 29 AQ (RC, 8-20, 4)

PRI J RANGE 8 TO 20, DELTA KPSI= 4

ABSOLU QUICKNESS (PSI/MICROSEC)

	2	3	4	5	6	AV	SD
J (	05 14.127	14.020	14.095	14.131	14.2..	14.117	.067
K	78 14.139	14.016	14.085	14.006	14.057	14.063	.049
L	86 13.866	14.024	14.029	14.015	14.048	14.011	.076
JL	69 14.071	14.038	14.172	14.028	14.097	14.079	.052
JKL	41 14.044	14.076	13.991	14.036	14.129	14.053	.046
JKLL	79 13.861	13.880	13.987	13.930	14.022	13.960	.085
M	02 14.097	14.015	14.156	13.910	14.081	14.010	.132
N	.77 14.647	14.496	14.333	14.475	14.575	14.501	.106
P	.960 12.723	12.739	12.818	12.735	12.796	12.712	.129
Q	11.453 11.337	11.601	11.489	11.536	11.371	11.465	.099
R	16.890 16.971	16.967	16.931	16.843	17.137	16.956	.101
S	15.456 15.386	15.617	15.420	15.135	15.608	15.437	.177
T	12.145 12.186	12.276	12.425	12.134	12.549	12.286	.168
U	10.364 10.363	10.434	10.518	10.504	10.531	10.452	.076
V	16.374 16.621	16.650	16.613	16.627	16.550	16.572	.103
W	14.600 14.750	14.512	14.595	14.781	14.834	14.679	.127
LL	13.740 13.746	13.660	13.816	13.909	13.861	13.789	.091
(J-K-L)	13.985 13.910	13.793	13.899	13.974	13.945	13.918	.070
(JL-JKL)	14.063 14.048	13.991	14.005	14.041	13.938	14.014	.046
(LL-JKLL)	13.796 14.300	14.176	14.237	14.417	13.881	14.134	.244
(M-N)	14 264 14.236	14.183	14.115	14.276	14.368	14.234	.075
(P-T)	13.923 14.012	14.091	14.074	14.0 8	14.375	14.091	.152
(Q-U)	14.170 14.317	14.228	14.198	14.3 7	14.333	14.264	.074
(R-S)	14.183 14.172	14.350	14.441	14.259	14.172	14.263	.111
(V-W)	14.283 14.386	14.435	14.047	14.002	14.514	14.278	.210
(6-HEX)	10.311 19.451	14.166	14.285	14.516	14.405	0.000	0.000

VEL7 = 1398.597 + 31.9693 X. R= .944 ALL LOTS.
VEL7 = 1375.303 + 33.7598 X. R= .919 EXCLUDE LOTS R,V.
VEL7 = 1387.016 + 32.9151 X. R= .793 EXCLUDE LOTS R,V,Q,U.
VEL7 = 960.427 + 62.5345 X. R= .875 EXCLUDE LOTS R,V,Q,U,P,T.
VEL7 = 1335.957 + 37.4426 X. R= .963 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL7 = 710.072 + 431.6159 X. R= .943 ALL LOTS LOG FIT.
VEL5 = 763.183 + 33.3426 X. R= .969 ALL LOTS.
VEL5 = 704.580 + 37.8400 X. R= .973 EXCLUDE LOTS R,V.
VEL5 = 612.117 + 44.3499 X. R= .955 EXCLUDE LOTS R,V,Q,U.
VEL5 = 409.719 + 58.4150 X. R= .944 EXCLUDE LOTS R,V,Q,U,P,T.
VEL5 = 674.214 + 40.2054 X. R= .990 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL5 = 40.943 + 451.7306 X. R= .971 ALL LOTS LOG FIT.

Table 30 AQ (9 C, 8-20, 4)

PRESSURE RANGE 8 TO 20. DELTA KPSI= 4

ABSOLUTE QUICKNESS (PSI/MICROSEC)

	1	2	3	4	5	6	AV	SD
J	3.653	3.676	3.627	3.655	3.650	3.689	3.658	.021
K	3.668	3.728	3.679	3.652	3.659	3.675	3.677	.027
L	3.656	3.629	3.640	3.685	3.661	3.659	3.655	.019
JL	3.667	3.644	3.646	3.691	3.649	3.695	3.665	.023
JKL	3.658	3.664	3.669	3.662	3.657	3.697	3.668	.015
JKLL	3.647	3.592	3.609	3.642	3.614	3.641	3.624	.022
M	3.465	3.548	3.535	3.569	3.496	3.564	3.530	.041
N	3.723	3.798	3.743	3.728	3.729	3.782	3.751	.032
P	3.147	3.216	3.255	3.247	3.234	3.270	3.228	.044
Q	2.845	2.845	2.909	2.870	2.872	2.856	2.866	.024
R	4.542	4.573	4.566	4.574	4.523	4.622	4.567	.034
S	4.016	4.012	4.065	4.017	3.917	4.077	4.017	.056
T	3.046	3.090	3.107	3.129	3.086	3.187	3.108	.048
U	2.524	2.568	2.587	2.596	2.581	2.619	2.579	.032
V	4.360	4.448	4.420	4.441	4.442	4.427	4.423	.033
W	3.797	3.837	3.758	3.785	3.845	3.862	3.814	.040
LL	3.544	3.565	3.527	3.567	3.619	3.614	3.573	.037
(J-K-L)	3.601	3.600	3.576	3.602	3.640	3.609	3.605	.021
(JL-JKL)	3.622	3.652	3.617	3.626	3.653	3.590	3.627	.024
(LL-JKLL)	3.548	3.593	3.669	3.691	3.737	3.612	3.658	.068
(M-N)	3.686	3.692	3.667	3.667	3.716	3.750	3.696	.032
(P-T)	3.587	3.626	3.655	3.667	3.655	3.732	3.653	.048
(Q-U)	3.685	3.726	3.698	3.706	3.744	3.730	3.715	.022
(R-S)	3.697	3.698	3.733	3.758	3.731	3.674	3.715	.031
(V-W)	3.713	3.764	3.757	3.650	3.655	3.784	3.721	.057
(6-HEX)	2.53[illegible]	5.143	3.691	3.728	3.790	3.734	0.000	0.000

VEL7 = 1466.908 + 104.5734 X. R= .937 ALL LOTS.
VEL7 = 1437.258 + 113.4533 X. R= .910 EXCLUDE LOTS R.V.
VEL7 = 1457.072 + 107.9855 X. R= .769 EXCLUDE LOTS R.V.Q.U.
VEL7 = 1062.815 + 213.5206 X. R= .846 EXCLUDE LOTS R.V.Q.U.P.T.
VEL7 = 1405.452 + 125.4329 X. R= .952 INCLUDE LOTS J.K.L.P.Q.S.T.U.W
VEL7 = 1378.241 + 365.8884 X. R= .938 ALL LOTS LOG FIT.
VEL5 = 833.572 + 109.3023 X. R= .964 ALL LOTS.
VEL5 = 769.975 + 128.3255 X. R= .973 EXCLUDE LOTS R.V.
VEL5 = 691.315 + 149.7017 X. R= .953 EXCLUDE LOTS R.V.Q.U.
VEL5 = 474.356 + 207.8214 X. R= .951 EXCLUDE LOTS R.V.Q.J.P.T.
VEL5 = 750.526 + 135.6619 X. R= .987 INCLUDE LOTS J.K.L.P.Q.S.T.U.W
VEL5 = 738.729 + 384.1329 X. R= .969 ALL LOTS LOG FIT.

Table 31 RQ (RC, 8-20, 4)

RELATIVE QUICKNESS

	1	2	3	4	5	6	AV	SD
J	100.81	101.73	101.52	101.59	101.05	102.00	101.45	.44
K	100.23	101.44	101.06	101.09	99.60	100.17	100.60	.70
L	100.60	99.72	101.58	100.89	100.09	100.61	100.58	.64
JL	99.86	99.92	100.27	101.08	99.76	100.89	100.30	.56
JKL	99.47	99.77	100.55	99.63	99.71	101.10	100.04	.64
JKLL	101.73	96.55	97.43	97.83	96.38	100.86	98.46	2.27
M	97.07	99.66	99.07	100.93	97.93	98.84	98.92	1.34
N	101.45	102.86	102.11	101.20	101.53	101.64	101.80	.60
P	89.07	90.79	90.39	91.41	90.46	88.55	90.11	1.08
Q	80.83	79.34	81.56	81.13	80.63	79.49	80.50	.90
R	119.20	120.04	118.28	117.11	118.24	121.09	118.99	1.42
S	109.38	109.06	109.15	106.93	106.55	110.49	108.59	1.53
T	87.11	86.92	87.15	88.61	86.16	87.02	87.16	.80
U	73.01	72.24	73.21	74.05	73.20	73.36	73.18	.58
V	114.87	115.88	115.79	118.85	119.32	114.42	116.52	2.07
W	102.56	103.17	100.89	104.61	106.20	102.53	103.33	1.85
LL	99.67	95.98	96.20	97.13	96.43	99.85	97.54	1.76

VEL7	=	1396.851	+ 4.5355	X.	R= .943	ALL LOTS.
VEL7	=	1387.262	+ 4.6401	X.	R= .915	EXCLUDE LOTS R.V.
VEL7	=	1381.164	+ 4.6980	X.	R= .779	EXCLUDE LOTS R.V.Q.U.
VEL7	=	788.490	+ 10.5084	X.	R= .908	EXCLUDE LOTS R.V.Q.U.P.T.
VEL7	=	1354.959	+ 5.0775	X.	R= .952	INCLUDE LOTS J.K.L.P.Q.S.T.U.W
VEL7	=	-114.705	+ 427.3028	X.	R= .939	ALL LOTS LOG FIT.
VEL5	=	760.701	+ 4.7370	X.	R= .969	ALL LOTS.
VEL5	=	719.051	+ 5.1898	X.	R= .966	EXCLUDE LOTS R.V.
VEL5	=	598.762	+ 6.3852	X.	R= .947	EXCLUDE LOTS R.V.Q.U.
VEL5	=	272.356	+ 9.5869	X.	R= .957	EXCLUDE LOTS R.V.Q.U.P.T.
VEL5	=	699.648	+ 5.4518	X.	R= .980	INCLUDE LOTS J.K.L.P.Q.S.T.U.W
VEL5	=	-823.951	+ 447.5829	X.	R= .968	ALL LOTS LOG FIT.
PP 7	=	-16.542	+ .5417	X.	R= .875	ALL LOTS.
PP 7	=	-10.009	+ .4707	X.	R= .786	EXCLUDE LOTS R.V.
PP 7	=	-28.987	+ .6595	X.	R= .707	EXCLUDE LOTS R.V.Q.U.
PP 7	=	-136.085	+ 1.7097	X.	R= .906	EXCLUDE LOTS R.V.Q.U.P.T.
PP 7	=	-15.890	+ .5504	X.	R= .883	INCLUDE LOTS J.K.L.P.Q.S.T.U.W
PP 7	=	-191.799	+ 49.8856	X.	R= .851	ALL LOTS LOG FIT.
PP 5	=	-2.906	+ .1661	X.	R= .915	ALL LOTS.
PP 5	=	-2.441	+ .1611	X.	R= .863	EXCLUDE LOTS R.V.
PP 5	=	-10.687	+ .2461	X.	R= .853	EXCLUDE LOTS R.V.Q.U.
PP 5	=	-35.388	+ .4854	X.	R= .946	EXCLUDE LOTS R.V.Q.U.P.T.
PP 5	=	-3.643	+ .1773	X.	R= .903	INCLUDE LOTS J.K.L.P.Q.S.T.U.W
PP 5	=	-57.173	+ 15.4123	X.	R= .897	ALL LOTS LOG FIT.

Table 32 RQ (9 C, 8-20, 4)

RELATIVE QUICKNESS

	1	2	3	4	5	6	AV	SD
J	101.27	102.27	101.31	101.71	99.82	102.05	101.41	.87
K	101.19	102.81	102.21	100.69	99.48	100.79	101.19	1.18
L	101.16	100.63	101.50	102.20	100.01	100.70	101.03	.77
JL	101.07	99.39	100.64	101.51	99.36	102.50	100.74	1.23
JKL	100.49	100.17	101.56	100.72	99.52	102.55	100.83	1.08
JKLL	102.19	96.62	97.71	98.00	96.13	100.40	98.51	2.33
M	95.14	97.74	97.61	99.03	95.56	96.55	96.94	1.46
N	100.94	103.45	102.46	101.79	100.83	101.17	101.77	1.02
P	87.41	88.48	89.14	88.84	88.58	87.23	88.28	.78
Q	77.04	76.54	78.65	77.54	76.52	76.50	77.13	.85
R	122.66	123.74	122.62	121.46	121.20	126.13	122.97	1.80
S	109.03	109.12	109.71	107.22	105.41	111.64	108.69	2.14
T	84.71	84.92	84.89	85.53	84.37	84.92	84.89	.38
U	67.90	68.38	69.73	69.60	68.34	69.61	68.93	.81
V	117.82	118.32	118.47	122.32	121.65	117.29	119.31	2.12
W	102.04	101.99	100.08	104.02	105.16	102.05	102.56	1.78
LL	99.88	96.09	95.90	96.54	96.59	99.95	97.49	1.90

VEL7 = 1466.614 + 3.8422 X. R= .933 ALL LOTS.
VEL7 = 1454.695 + 3.9740 X. R= .899 EXCLUDE LOTS R.V.
VEL7 = 1462.706 + 3.8914 X. R= .734 EXCLUDE LOTS R.V.Q.U.
VEL7 = 926.150 + 9.1544 X. R= .837 EXCLUDE LOTS R.V.Q.U.P.T.
VEL7 = 1424.237 + 4.3993 X. R= .941 INCLUDE LOTS J.K.L.P.Q.S.T.U.W
VEL7 = 203.212 + 358.4532 X. R= .929 ALL LOTS LOG FIT.
VEL5 = 832.631 + 4.0224 X. R= .961 ALL LOTS.
VEL5 = 791.064 + 4.4806 X. R= .957 EXCLUDE LOTS R.V.
VEL5 = 690.155 + 5.4853 X. R= .925 EXCLUDE LOTS R.V.Q.U.
VEL5 = 367.684 + 8.6502 X. R= .914 EXCLUDE LOTS R.V.Q.U.P.T.
VEL5 = 772.385 + 4.7414 X. R= .972 INCLUDE LOTS J.K.L.P.Q.S.T.U.W
VEL5 = -495.863 + 376.5394 X. R= .961 ALL LOTS LOG FIT.

Table 33 RQA (RC, 8-20, 4)

RELATIVE QUICKNESS BY AVERAGED REFERENCE FIRINGS

	1	2	3	4	5	6	AV	SD
J	101.39	101.51	100.62	101.29	101.58	102.28	101.45	.53
K	100.81	101.23	100.17	100.80	100.11	100.43	100.59	.43
L	101.19	99.52	100.68	100.60	100.61	100.88	100.58	.57
JL	100.26	100.21	99.92	101.02	99.96	100.38	100.29	.40
JKL	99.86	100.07	100.21	99.57	99.91	100.59	100.03	.35
JKLL	99.33	97.66	97.83	98.59	98.26	98.91	98.43	.64
M	97.39	99.61	98.75	100.04	98.15	99.54	98.91	1.01
N	101.78	102.81	101.78	100.32	101.76	102.35	101.80	.84
P	88.18	90.27	90.15	91.06	90.28	90.65	90.10	1.00
Q	80.24	79.71	81.35	80.68	81.05	79.92	80.49	.64
R	118.56	119.12	119.08	118.74	118.09	120.31	118.98	.75
S	108.79	108.22	109.89	108.42	106.42	109.79	108.59	1.27
T	86.25	86.43	86.91	88.27	85.98	89.09	87.15	1.25
U	72.48	72.58	73.01	73.64	73.58	73.76	73.18	.56
V	114.99	116.72	117.33	116.70	116.90	116.33	116.49	.80
W	102.68	103.92	102.23	102.70	104.04	104.24	103.30	.86
LL	97.32	97.08	96.60	97.89	98.31	97.91	97.52	.63

VEL7 = 1396.781 + 4.5366 X. R= .943 ALL LOTS.
VEL7 = 1387.257 + 4.6406 X. R= .914 EXCLUDE LOTS R,V.
VEL7 = 1381.401 + 4.6961 X. R= .779 EXCLUDE LOTS R,V,Q,U.
VEL7 = 789.843 + 10.4960 X. R= .908 EXCLUDE LOTS R,V,Q,U,P,T.
VEL7 = 1354.912 + 5.0784 X. R= .952 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL7 = -114.982 + 427.3719 X. R= .939 ALL LOTS LOG FIT.
VEL5 = 760.623 + 4.7382 X. R= .969 ALL LOTS.
VEL5 = 719.038 + 5.1904 X. R= .966 EXCLUDE LOTS R,V.
VEL5 = 599.062 + 6.3828 X. R= .947 EXCLUDE LOTS R,V,Q,U.
VEL5 = 273.858 + 9.5729 X. R= .956 EXCLUDE LOTS R,V,Q,U,P,T.
VEL5 = 699.583 + 5.4529 X. R= .980 INCLUDE LOTS J,K,L,P,S,T,U,W
VEL5 = -824.265 + 447.6602 X. R= .967 ALL LOTS LOG FIT.

Table 34 RQA (9 C, 8-20, 4)

RELATIVE QUICKNESS BY AVERAGED REFERENCE FIRINGS

	1	2	3	4	5	6	AV	SD
J	101.24	102.07	100.40	101.36	101.07	102.25	101.40	.68
K	101.15	102.63	101.29	100.37	100.70	100.98	101.19	.78
L	101.12	100.44	100.59	101.86	101.26	100.90	101.03	.51
JL	100.92	100.07	99.99	101.46	100.36	101.60	100.73	.70
JKL	100.34	100.85	100.89	100.67	100.52	101.66	100.82	.46
JKLL	99.19	97.51	98.16	98.92	98.10	98.95	98.47	.65
M	95.18	97.55	96.65	98.13	96.11	97.95	96.93	1.16
N	100.95	103.26	101.46	100.88	101.41	102.64	101.77	.96
P	85.90	87.91	88.83	88.95	88.48	89.53	88.27	1.28
Q	76.40	76.89	78.07	77.29	77.26	76.85	77.13	.56
R	122.24	123.07	123.05	122.99	121.69	124.69	122.95	1.01
S	108.66	108.53	110.08	108.57	105.83	110.36	108.67	1.61
T	83.25	84.38	84.61	85.64	84.28	87.15	84.88	1.35
U	67.34	68.67	69.22	69.39	68.98	69.93	68.92	.88
V	117.67	119.86	119.73	119.66	119.50	119.27	119.28	.82
W	101.90	103.32	101.14	101.76	103.30	103.77	102.53	1.07
LL	96.96	96.96	96.35	97.46	98.57	98.51	97.47	.90

VEL7 = 1466.540 + 3.8435 X. R= .933 ALL LOTS.
VEL7 = 1454.646 + 3.9750 X. R= .899 EXCLUDE LOTS R,V.
VEL7 = 1462.752 + 3.8914 X. R= .734 EXCLUDE LOTS R,V,Q,U.
VEL7 = 927.218 + 9.1451 X. R= .837 EXCLUDE LOTS R,V,Q,U,P,T.
VEL7 = 1424.194 + 4.4002 X. R= .941 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL7 = 202.911 + 358.5293 X. R= .929 ALL LOTS LOG FIT.
VEL5 = 832.557 + 4.0237 X. R= .961 ALL LOTS.
VEL5 = 791.014 + 4.4817 X. R= .957 EXCLUDE LOTS R,V.
VEL5 = 690.241 + 5.4852 X. R= .925 EXCLUDE LOTS R,V,Q,U.
VEL5 = 368.899 + 8.6394 X. R= .913 EXCLUDE LOTS R,V,Q,U,P,T.
VEL5 = 772.329 + 4.7425 X. R= .972 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL5 = -496.166 + 376.6161 X. R= .961 ALL LOTS LOG FIT.

TABLE 35. REFERENCE SELF RQ. (RC, 8-20,4)

(J-K-L)	100.00	99.22	98.55	99.14	99.94	99.69
(J-K-L)	100.79	100.00	99.33	99.91	100.73	100.48
(J-K-L)	101.48	100.69	100.00	100.59	101.41	101.16
(J-K-L)	100.88	100.09	99.41	100.00	100.82	100.57
(J-K-L)	100.06	99.29	98.61	99.20	100.00	99.75
(J-K-L)	100.31	99.53	98.85	99.44	100.25	100.00
(JL-JKL)	100.00	99.90	99.26	99.54	99.80	99.10
(JL-JKL)	100.11	100.00	99.37	99.65	99.90	99.21
(JL-JKL)	100.75	100.65	100.00	100.29	100.55	99.85
(JL-JKL)	100.46	100.35	99.72	100.00	100.26	99.56
(JL-JKL)	100.20	100.10	99.46	99.74	100.00	99.30
(JL-JKL)	100.91	100.80	100.16	100.44	100.70	100.00
(LL-JKLL)	100.00	103.60	102.84	103.21	104.41	100.43
(LL-JKLL)	96.53	100.00	99.27	99.63	100.78	96.94
(LL-JKLL)	97.24	100.74	100.00	100.37	101.53	97.66
(LL-JKLL)	96.89	100.38	99.64	100.00	101.16	97.31
(LL-JKLL)	95.78	99.22	98.49	98.85	100.00	96.19
(LL-JKLL)	99.58	103.16	102.40	102.77	103.97	100.00
(M-N)	100.00	99.64	99.37	98.81	99.91	100.38
(M-N)	100.37	100.00	99.74	99.17	100.28	100.75
(M-N)	100.64	100.27	100.00	99.44	100.54	101.02
(M-N)	101.21	100.83	100.57	100.00	101.11	101.59
(M-N)	100.09	99.73	99.46	98.90	100.00	100.47
(M-N)	99.62	99.26	98.99	98.44	99.53	100.00
(P-T)	100.00	100.43	100.74	100.63	100.80	103.41
(P-T)	99.58	100.00	100.31	100.20	100.37	102.98
(P-T)	99.29	99.70	100.00	99.90	100.07	102.69
(P-T)	99.40	99.81	100.10	100.00	100.18	102.80
(P-T)	99.22	99.63	99.94	99.83	100.00	102.61
(P-T)	96.71	97.12	97.43	97.33	97.48	100.00
(Q-U)	100.00	101.20	100.46	100.17	101.26	101.29
(Q-U)	98.82	100.00	99.27	98.99	100.06	100.08
(Q-U)	99.54	100.74	100.00	99.71	100.79	100.82
(Q-U)	99.83	101.03	100.29	100.00	101.08	101.11
(Q-U)	98.76	99.94	99.21	98.93	100.00	100.03
(Q-U)	98.73	99.92	99.19	98.90	99.97	100.00
(R-S)	100.00	99.77	101.22	101.94	100.42	99.90
(R-S)	100.23	100.00	101.45	102.18	100.65	100.13
(R-S)	98.80	98.57	100.00	100.72	99.21	98.70
(R-S)	98.09	97.88	99.29	100.00	98.51	98.00
(R-S)	99.58	99.36	100.80	101.52	100.00	99.49
(R-S)	100.10	99.87	101.32	102.04	100.52	100.00
(V-W)	100.00	100.61	101.21	98.10	97.87	101.56
(V-W)	99.39	100.00	100.59	97.50	97.27	100.94
(V-W)	98.81	99.42	100.00	96.95	96.71	100.36
(V-W)	101.95	102.57	103.19	100.00	99.77	103.54
(V-W)	102.18	102.80	103.42	100.23	100.00	103.77
(V-W)	98.46	99.07	99.66	96.59	96.37	100.00

TABLE 36. REFERENCE SELF RQ. (9pt, 8-20,4)

(J-K-L)	100.00	99.85	99.14	99.70	101.31	100.24
(J-K-L)	100.16	100.00	99.29	99.85	101.47	100.40
(J-K-L)	100.88	100.72	100.00	100.57	102.20	101.12
(J-K-L)	100.31	100.15	99.44	100.00	101.63	100.55
(J-K-L)	98.72	98.57	97.87	98.43	100.00	98.95
(J-K-L)	99.76	99.61	98.90	99.47	101.07	100.00
(JL-JKL)	100.00	100.83	99.50	100.10	101.17	99.28
(JL-JKL)	99.17	100.00	98.68	99.27	100.33	98.46
(JL-JKL)	100.52	101.37	100.00	100.62	101.72	99.81
(JL-JKL)	99.91	100.74	99.41	100.00	101.08	99.19
(JL-JKL)	98.86	99.68	98.38	98.95	100.00	98.14
(JL-JKL)	100.73	101.57	100.23	100.82	101.90	100.00
(LL-JKLL)	100.00	103.96	103.50	103.99	105.13	101.52
(LL-JKLL)	96.20	100.00	99.57	100.03	101.13	97.66
(LL-JKLL)	96.62	100.44	100.00	100.47	101.58	98.09
(LL-JKLL)	96.17	99.97	99.53	100.00	101.10	97.63
(LL-JKLL)	95.13	98.89	98.46	98.92	100.00	96.57
(LL-JKLL)	98.51	102.40	101.96	102.44	103.56	100.00
(M-N)	100.00	99.82	99.03	99.12	100.57	101.45
(M-N)	100.19	100.00	99.20	99.29	100.75	101.63
(M-N)	101.01	100.81	100.00	100.10	101.57	102.45
(M-N)	100.91	100.71	99.91	100.00	101.47	102.36
(M-N)	99.44	99.26	98.47	98.55	100.00	100.87
(M-N)	98.58	98.40	97.61	97.70	99.13	100.00
(P-T)	100.00	101.10	101.41	101.89	101.64	104.47
(P-T)	98.91	100.00	100.31	100.78	100.54	103.32
(P-T)	98.65	99.74	100.00	100.49	100.25	103.08
(P-T)	98.16	99.24	99.52	100.00	99.76	102.56
(P-T)	98.39	99.47	99.76	100.24	100.00	102.79
(P-T)	95.75	96.80	97.13	97.58	97.33	100.00
(Q-U)	100.00	101.29	100.09	100.52	101.81	101.31
(Q-U)	98.73	100.00	98.82	99.25	100.51	100.02
(Q-U)	99.92	101.21	100.00	100.44	101.73	101.23
(Q-U)	99.49	100.77	99.57	100.00	101.29	100.79
(Q-U)	98.23	99.49	98.32	98.74	100.00	99.51
(Q-U)	98.71	99.98	98.80	99.23	100.49	100.00
(R-S)	100.00	99.80	100.70	101.60	100.74	99.19
(R-S)	100.21	100.00	100.90	101.82	100.95	99.40
(R-S)	99.32	99.11	100.00	100.91	100.05	98.51
(R-S)	98.42	98.22	99.10	100.00	99.15	97.63
(R-S)	99.27	99.06	99.95	100.86	100.00	98.47
(R-S)	100.82	100.61	101.51	102.43	101.56	100.00
(V-W)	100.00	101.44	101.20	98.00	98.37	101.83
(V-W)	98.59	100.00	99.76	96.62	96.98	100.39
(V-W)	98.82	100.24	100.00	96.84	97.21	100.63
(V-W)	102.07	103.55	103.29	100.00	100.41	103.94
(V-W)	101.66	103.12	102.88	99.63	100.00	103.53
(V-W)	98.20	99.61	99.38	96.23	96.60	100.00

Table 37 AQ (RC, 8-20, 1)

PRESSURE RANGE 8 TO 20. DELTA KPSI= 1

ABSOLUTE QUICKNESS (PSI/MICROSEC)

	1	2	3	4	5	6	AV	SD
J	14.076	14.102	13.969	14.045	14.078	14.152	14.070	.061
K	14.013	14.039	13.983	14.027	13.952	14.002	14.002	.032
L	14.016	13.849	13.966	13.994	13.958	13.940	13.954	.058
JL	14.002	14.020	13.994	14.094	13.973	14.057	14.023	.045
JKL	13.978	13.990	14.032	13.909	13.984	14.077	13.995	.056
JKLL	14.030	13.802	13.843	13.949	13.871	13.945	13.907	.083
M	13.840	14.154	14.081	14.193	13.957	14.123	14.058	.134
N	14.446	14.640	14.456	14.382	14.494	14.564	14.497	.092
P	12.455	12.707	12.701	12.774	12.704	12.799	12.690	.122
Q	11.358	11.285	11.587	11.397	11.460	11.313	11.400	.111
R	16.863	16.930	16.934	16.881	16.793	17.080	16.913	.096
S	15.445	15.368	15.592	15.390	15.090	15.588	15.412	.184
T	12.089	12.134	12.225	12.373	12.088	12.511	12.237	.172
U	10.268	10.305	10.378	10.422	10.400	10.424	10.366	.065
V	16.320	16.580	16.589	16.526	16.555	16.490	16.510	.100
W	14.486	14.638	14.406	14.502	14.680	14.738	14.575	.129
LL	13.660	13.709	13.585	13.729	13.848	13.818	13.725	.098
(J-K-L)	13.936	13.913	13.753	13.847	13.970	13.922	13.890	.079
(JL-JKL)	14.012	14.007	13.945	13.960	14.043	13.912	13.980	.049
(LL-JKLL)	13.770	14.255	14.153	14.187	14.406	13.865	14.106	.241
(M-N)	14.242	14.212	14.152	14.073	14.217	14.277	14.196	.073
(P-T)	13.869	14.012	14.074	14.059	14.042	14.345	14.063	.148
(Q-U)	14.141	14.283	14.167	14.144	14.314	14.290	14.223	.081
(R-S)	14.156	14.151	14.276	14.380	14.237	14.157	14.226	.091
(V-W)	14.224	14.353	14.342	14.013	13.969	14.449	14.225	.195
(6-HEX)	10.269	19.437	14.126	14.341	14.463	14.374	0.000	0.000

VEL7 = 1401.965 + 31.8340 X. R= .944 ALL LOTS.
VEL7 = 1381.151 + 33.4410 X. R= .918 EXCLUDE LOTS R.V.
VEL7 = 1390.752 + 32.7431 X. R= .788 EXCLUDE LOTS R.V.Q.U.
VEL7 = 979.790 + 61.3583 X. R= .861 EXCLUDE LOTS R.V.Q.U.P.T.
VEL7 = 1339.094 + 37.3675 X. R= .964 INCLUDE LOTS J.K.L.P.Q.S.T.U.W
VEL7 = 722.812 + 427.3313 X. R= .942 ALL LOTS LOG FIT.
VEL5 = 767.159 + 33.1682 X. R= .968 ALL LOTS.
VEL5 = 712.168 + 37.4062 X. R= .970 EXCLUDE LOTS R.V.
VEL5 = 619.527 + 44.0195 X. R= .947 EXCLUDE LOTS R.V.Q.U.
VEL5 = 434.447 + 56.8503 X. R= .921 EXCLUDE LOTS R.V.Q.U.P.T.
VEL5 = 683.931 + 40.0225 X. R= .990 INCLUDE LOTS J.K.L.P.Q.S.T.U.W
VEL5 = 55.567 + 446.7551 X. R= .969 ALL LOTS LOG FIT.

Table 38 AQ (9 C, 8-20, 1)

PRESSURE RANGE 8 TO 20. DELTA KPSI= 1

ABSOLUTE QUICKNESS (PSI/MICROSEC)

	1	2	3	4	5	6	AV	SD
J	3.647	3.660	3.625	3.639	3.651	3.673	3.649	.016
K	3.657	3.680	3.659	3.660	3.646	3.666	3.661	.011
L	3.643	3.600	3.634	3.653	3.634	3.634	3.633	.018
JL	3.644	3.651	3.645	3.678	3.640	3.673	3.655	.016
JKL	3.651	3.643	3.659	3.631	3.650	3.674	3.651	.015
JKLL	3.643	3.586	3.594	3.630	3.607	3.626	3.614	.022
M	3.508	3.595	3.581	3.608	3.541	3.585	3.570	.038
N	3.748	3.812	3.757	3.749	3.752	3.784	3.767	.026
P	3.154	3.223	3.239	3.234	3.222	3.256	3.221	.035
Q	2.846	2.812	2.896	2.843	2.862	2.819	2.846	.030
R	4.535	4.563	4.557	4.553	4.521	4.603	4.555	.028
S	4.028	4.016	4.075	4.024	3.930	4.079	4.025	.054
T	3.037	3.066	3.094	3.119	3.059	3.169	3.091	.048
U	2.543	2.547	2.572	2.582	2.571	2.585	2.567	.018
V	4.343	4.429	4.394	4.417	4.420	4.400	4.400	.031
W	3.768	3.803	3.726	3.757	3.819	3.843	3.786	.043
LL	3.513	3.547	3.504	3.539	3.592	3.584	3.547	.036
(J-K-L)	3.595	3.603	3.553	3.595	3.610	3.593	3.591	.020
(JL-JKL)	3.627	3.630	3.621	3.615	3.637	3.592	3.620	.016
(LL-JKLL)	3.539	3.692	3.654	3.671	3.741	3.585	3.647	.073
(M-N)	3.686	3.692	3.665	3.649	3.697	3.712	3.684	.023
(P-T)	3.567	3.616	3.653	3.651	3.636	3.699	3.637	.044
(Q-U)	3.675	3.709	3.686	3.682	3.723	3.713	3.698	.020
(R-S)	3.673	3.674	3.711	3.734	3.703	3.668	3.694	.026
(V-W)	3.694	3.739	3.724	3.636	3.625	3.764	3.697	.057
(6-HEX)	2.537	5.128	3.677	3.714	3.740	3.721	0.000	0.000

VEL7 = 1468.029 + 104.5099 X. R= .937 ALL LOTS.
VEL7 = 1442.261 + 112.2548 X. R= .910 EXCLUDE LOTS R,V.
VEL7 = 1461.503 + 106.9332 X. R= .769 EXCLUDE LOTS R,V,Q,U.
VEL7 = 1052.767 + 216.5055 X. R= .852 EXCLUDE LOTS R,V,Q,U,P,T.
VEL7 = 1407.574 + 125.3082 X. R= .956 INCLUDE LOTS J,K,L,P,Q,S,T U,W
VEL7 = 1382.096 + 363.5679 X. R= .937 ALL LOTS LOG FIT.
VEL5 = 834.820 + 109.2150 X. R= .964 ALL LOTS.
VEL5 = 776.309 + 126.7759 X. R= .971 EXCLUDE LOTS R,V.
VEL5 = 699.981 + 147.5441 X. R= .948 EXCLUDE LOTS R,V,Q,U.
VEL5 = 477.408 + 207.2597 X. R= .942 EXCLUDE LOTS R,V,Q,U,P,T.
VEL5 = 753.997 + 135.1800 X. R= .988 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL5 = 742.872 + 381.6220 X. R= .968 ALL LOTS LOG FIT.

Table 39 RQ (RC, 8-20, 1)

RELATIVE QUICKNESS

	1	2	3	4	5	6	AV	SD
J	100.95	101.39	101.43	101.51	100.63	101.56	101.25	.37
K	100.19	100.60	101.20	101.03	99.38	100.07	100.41	.67
L	100.51	99.54	101.47	101.03	99.72	100.00	100.38	.76
JL	99.75	99.92	100.34	100.83	99.34	100.88	100.18	.62
JKL	99.49	99.68	100.58	99.42	99.37	100.99	99.92	.69
JKLL	101.63	96.53	97.46	97.97	96.02	100.38	98.33	2.22
M	97.28	100.00	99.69	101.25	98.45	99.33	99.33	1.36
N	101.33	102.96	102.02	101.97	102.09	101.93	102.05	.52
P	89.58	90.59	90.27	91.04	90.49	89.00	90.16	.75
Q	80.27	79.07	81.85	80.70	80.08	79.25	80.20	1.02
R	119.16	119.74	118.69	117.28	118.03	120.73	118.94	1.23
S	109.32	108.87	109.40	107.12	106.19	110.29	108.53	1.55
T	87.06	86.47	86.83	88.16	85.97	87.11	86.93	.73
U	72.38	71.97	73.05	73.61	72.52	72.76	72.72	.57
V	114.90	115.75	116.11	118.33	118.78	114.38	116.38	1.80
W	102.01	102.32	100.72	103.89	105.42	102.45	102.77	1.65
LL	99.28	96.08	95.88	96.79	96.06	99.65	97.29	1.72

VEL7 = 1400.757 + 4.5017 X. R= .941 ALL LOTS.
VEL7 = 1392.984 + 4.5869 X. R= .912 EXCLUDE LOTS R,V.
VEL7 = 1385.322 + 4.6604 X. R= .771 EXCLUDE LOTS R,V,Q,U.
VEL7 = 788.090 + 10.5219 X. R= .895 EXCLUDE LOTS R,V,Q,U,P,T.
VEL7 = 1357.697 + 5.0612 X. R= .953 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL7 = -92.307 + 422.5492 X. R= .937 ALL LOTS LOG FIT.
VEL5 = 765.012 + 4.6994 X. R= .967 ALL LOTS.
VEL5 = 725.939 + 5.1252 X. R= .963 EXCLUDE LOTS R,V.
VEL5 = 603.171 + 6.3467 X. R= .939 EXCLUDE LOTS R,V,Q,U.
VEL5 = 276.461 + 9.5551 X. R= .939 EXCLUDE LOTS R,V,Q,U,P,T.
VEL5 = 703.697 + 5.4225 X. R= .978 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL5 = -799.268 + 442.3370 X. R= .965 ALL LOTS LOG FIT.

Table 40 RQ (9 C, 8-20, 1)

RELATIVE QUICKNESS

	1	2	3	4	5	6	AV	SD
J	101.20	101.51	101.85	101.29	100.80	101.98	101.43	.44
K	101.17	101.60	102.44	101.50	100.27	101.34	101.39	.70
L	101.01	99.73	102.01	101.46	100.19	100.69	100.85	.83
JL	100.16	100.29	100.47	101.36	99.65	101.76	100.62	.79
JKL	100.22	100.05	100.94	100.07	99.83	101.85	100.49	.77
JKLL	102.51	96.56	97.82	98.34	95.92	100.87	98.67	2.55
M	95.76	98 33	98.53	99.88	96.63	97.50	97.77	1.47
N	101.65	10' .52	102.66	102.78	101.83	102.13	102.43	.69
P	88.24	89.06	88.67	88.75	88.67	87.76	88.52	.46
Q	77.24	75.74	78.62	77.27	76.70	75.87	76.91	1.06
R	123.48	124.19	123.00	121.76	122.10	125.61	123.36	1.42
S	110.00	109.66	110.30	108.00	106.34	111.53	109.30	1.85
T	84.97	84.54	84.59	85.54	83.98	85.39	84.84	.58
U	68.69	68.20	69.49	69.82	68.68	69.18	69.01	.60
V	117.71	118.54	118.66	121.84	121.95	116.97	119.28	2.12
W	101.81	101.64	100.15	103.34	105.22	102.04	102.37	1.73
LL	99.17	95.66	95.65	96.26	95.73	99.83	97.05	1.92

VEL7 = 1467.563 + 3.8276 X. R= .934 ALL LOTS.
VEL7 = 1456.094 + 3.9543 X. R= .901 EXCLUDE LOTS R.V.
VEL7 = 1460.696 + 3.9057 X. R= .743 EXCLUDE LOTS R.V.Q.U.
VEL7 = 922.906 + 9.1716 X. R= .853 EXCLUDE LOTS R.V.Q.U.P.T.
VEL7 = 1425.481 + 4.3832 X. R= .944 INCLUDE LOTS J.K.L.P.Q.S.T.U.W
VEL7 = 207.944 + 357.3258 X. R= .931 ALL LOTS LOG FIT.
VEL5 = 833.975 + 4.0036 X. R= .962 ALL LOTS.
VEL5 = 793.360 + 4.4509 X. R= .958 EXCLUDE LOTS R.V.
VEL5 = 692.019 + 5.4581 X. R= .928 EXCLUDE LOTS R.V.Q.U.
VEL5 = 373.606 + 8.5779 X. R= .922 EXCLUDE LOTS R.V.Q.U.P.T.
VEL5 = 774.436 + 4.7164 X. R= .973 INCLUDE LOTS J.K.L.P.Q.S.T.U.W
VEL5 = -489.571 + 375.0665 X. R= .961 ALL LOTS LOG FIT.

Table 41 AQ (RC, 4-28, 2)

PRESSURE RANGE 4 TO 28. DELTA KPSI= 2

ABSOLUTE QUICKNESS (PSI/MICROSEC)

	1	2	3	4	5	6	AV	SD
J	15.096	15.280	15.251	15.134	15.238	15.261	15.210	.076
K	14.699	15.014	15.059	14.861	14.885	14.917	14.906	.127
L	14.671	14.614	14.736	14.825	14.744	14.693	14.714	.072
JL	14.786	14.892	14.991	15.220	14.879	14.932	14.950	.149
JKL	14.914	14.829	14.876	14.791	14.844	15.043	14.883	.089
JKLL	14.348	14.283	14.345	14.591	14.518	14.611	14.449	.141
M	13.931	14.347	14.302	14.398	14.069	14.329	14.229	.186
N	15.346	15.534	15.344	15.331	15.308	15.446	15.385	.087
P	13.428	13.926	13.930	13.983	13.870	14.222	13.893	.259
Q	12.522	12.390	12.760	12.631	12.695	12.499	12.583	.137
R	18.675	18.765	18.795	18.782	18.628	18.925	18.762	.104
S	16.536	16.559	16.726	16.625	16.161	16.836	16.574	.231
T	12.827	13.178	13.198	13.291	13.056	13.515	13.194	.261
U	10.831	11.029	11.042	11.213	10.860	11.327	11.017	.249
V	17.725	18.141	17.929	18.069	18.202	18.127	18.032	.177
W	15.774	15.882	15.599	15.607	16.051	16.067	15.830	.207
LL	13.514	13.824	13.384	13.891	14.435	14.417	13.911	.441
(J-K-L)	14.164	14.645	14.616	14.607	14.833	14.545	14.568	.221
(JL-JKL)	14.517	14.933	15.001	14.856	14.855	14.573	14.789	.198
(LL-JKLL)	13.701	14.687	14.698	14.722	15.098	14.618	14.587	.466
(M-N)	14.854	14.952	15.134	15.090	15.108	15.102	15.040	.112
(P-T)	14.845	15.075	15.342	15.374	15.359	15.588	15.264	.262
(Q-U)	15.433	15.618	15.738	15.604	15.739	15.686	15.636	.115
(R-S)	15.614	15.535	15.830	15.832	15.703	15.401	15.652	.170
(V-W)	15.518	15.831	15.845	15.484	15.263	15.974	15.653	.272
(6-HEX)	10.831	20.498	15.372	15.692	15.825	15.843	0.000	0.000

VEL7 = 1419.660 + 28.5128 X. R= .956 ALL LOTS.
VEL7 = 1348.375 + 33.6220 X. R= .955 EXCLUDE LOTS R,V.
VEL7 = 1342.005 + 34.0420 X. R= .883 EXCLUDE LOTS R,V,Q,U.
VEL7 = 1201.196 + 43.2024 X. R= .889 EXCLUDE LOTS R,V,Q,U,P,T.
VEL7 = 1323.018 + 35.8070 X. R= .981 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL7 = 705.809 + 422.7244 X. R= .962 ALL LOTS LOG FIT.
VEL5 = 797.713 + 28.8952 X. R= .953 ALL LOTS.
VEL5 = 693.595 + 36.3538 X. R= .975 EXCLUDE LOTS R,V.
VEL5 = 620.442 + 41.2240 X. R= .956 EXCLUDE LOTS R,V,Q,U.
VEL5 = 654.108 + 39.0674 X. R= .928 EXCLUDE LOTS R,V,Q,U,P,T.
VEL5 = 678.683 + 37.5090 X. R= .985 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL5 = 69.675 + 430.1059 X. R= .963 ALL LOTS LOG FIT.

Table 42 AQ (9 C, 4-28, 2)

PRESSURE RANGE 4 TO 28, DELTA KPSI= 2

ABSOLUTE QUICKNESS (PSI/MICROSEC)

	1	2	3	4	5	6	AV	SD
J	3.532	3.605	3.609	3.543	3.582	3.581	3.575	.032
K	3.409	3.509	3.547	3.468	3.477	3.492	3.484	.046
L	3.406	3.403	3.443	3.471	3.438	3.417	3.430	.026
JL	3.434	3.479	3.511	3.586	3.476	3.490	3.496	.051
JKL	3.492	3.459	3.474	3.450	3.466	3.529	3.478	.028
JKLL	3.311	3.297	3.314	3.385	3.364	3.394	3.344	.042
M	3.171	3.297	3.280	3.313	3.227	3.291	3.263	.054
N	3.603	3.664	3.597	3.612	3.583	3.638	3.616	.030
P	3.111	3.282	3.272	3.309	3.254	3.405	3.272	.095
Q	2.896	2.870	2.959	2.942	2.956	2.906	2.921	.036
R	4.702	4.731	4.760	4.743	4.675	4.775	4.731	.037
S	3.949	3.987	4.013	4.004	3.848	4.067	3.978	.074
T	2.929	3.048	3.044	3.062	3.014	3.172	3.045	.079
U	2.389	2.492	2.498	2.538	2.438	2.576	2.488	.068
V	4.289	4.445	4.340	4.415	4.474	4.461	4.404	.074
W	3.733	3.774	3.690	3.675	3.838	3.837	3.758	.071
LL	3.121	3.198	3.103	3.207	3.349	3.352	3.222	.108
(J-K-L)	3.259	3.409	3.411	3.393	3.465	3.375	3.386	.069
(JL-JKL)	3.352	3.498	3.513	3.471	3.472	3.378	3.447	.066
(LL-JKLL)	3.145	3.397	3.404	3.412	3.509	3.394	3.377	.122
(M-N)	3.462	3.486	3.556	3.544	3.531	3.527	3.517	.036
(P-T)	3.473	3.559	3.647	3.666	3.666	3.721	3.622	.090
(Q-U)	3.691	3.735	3.813	3.745	3.797	3.767	3.758	.044
(R-S)	3.767	3.726	3.826	3.811	3.789	3.660	3.763	.062
(V-W)	3.694	3.823	3.831	3.729	3.632	3.867	3.763	.092
(6-HEX)	2.445	4.890	3.655	3.750	3.810	3.801	0.000	0.000

VEL7 = 1496.231 + 99.1105 X. R= .945 ALL LOTS.
VEL7 = 1396.847 + 128.9295 X. R= .960 EXCLUDE LOTS R.V.
VEL7 = 1411.099 + 125.4877 X. R= .998 EXCLUDE LOTS R.V.Q.U.
VEL7 = 1346.305 + 143.2180 X. R= .885 EXCLUDE LOTS R.V.Q.U.P.T.
VEL7 = 1377.494 + 136.5599 X. R= .985 INCLUDE LOTS J.K.L.P.Q.S.T.U.W
VEL7 = 1400.111 + 356.6705 X. R= .960 ALL LOTS LOG FIT.
VEL5 = 879.630 + 99.2120 X. R= .930 ALL LOTS.
VEL5 = 753.296 + 137.8823 X. R= .970 EXCLUDE LOTS R.V.
VEL5 = 722.388 + 146.7086 X. R= .939 EXCLUDE LOTS R.V.Q.U.
VEL5 = 784.725 + 129.8041 X. R= .927 EXCLUDE LOTS R.V.Q.U.P.T.
VEL5 = 738.591 + 142.1965 X. R= .993 INCLUDE LOTS J.K.L.P.Q.S.T.U.W
VEL5 = 781.007 + 356.9638 X. R= .951 ALL LOTS LOG FIT.

Table 43 RQ (RC, 4-28, 2)

RELATIVE QUICKNESS

	1	2	3	4	5	6	AV	SD
J	107.73	104.72	104.42	104.31	103.11	105.02	104.88	1.54
K	103.38	101.98	102.32	101.39	99.73	101.77	101.76	1.20
L	103.31	99.31	100.44	101.36	99.10	100.19	100.62	1.55
JL	101.41	99.64	99.90	102.16	99.74	101.90	100.79	1.16
JKL	101.91	99.11	99.23	99.24	99.33	102.44	100.21	1.53
JKLL	105.15	96.84	97.35	98.55	95.62	99.45	98.83	3.37
M	95.33	97.59	96.51	97.16	94.97	96.59	96.36	1.03
N	103.32	103.90	101.67	101.33	101.69	102.36	102.38	1.03
P	90.45	92.09	91.08	91.37	90.42	90.67	91.01	.64
Q	81.97	79.88	82.19	81.90	81.47	80.37	81.30	.95
R	118.91	120.39	118.04	117.95	118.30	122.04	119.27	1.63
S	107.34	107.70	106.99	105.76	104.20	110.06	107.01	1.97
T	87.49	87.81	86.92	88.04	85.85	87.94	87.34	.83
U	71.29	71.99	72.42	73.66	71.54	73.89	72.46	1.09
V	114.88	115.87	114.78	118.14	119.95	114.33	116.33	2.24
W	102.89	102.18	100.09	102.03	106.32	102.14	102.78	2.03
LL	97.37	93.44	90.98	93.73	95.26	98.14	94.82	2.67

VEL7 = 1397.630 + 4.5195 X. R= .941 ALL LOTS.
VEL7 = 1391.030 + 4.5916 X. R= .912 EXCLUDE LOTS R.V.
VEL7 = 1383.782 + 4.6616 X. R= .765 EXCLUDE LOTS R.V.Q.U.
VEL7 = 904.509 + 9.3500 X. R= .840 EXCLUDE LOTS R.V.Q.U.P.T.
VEL7 = 1361.979 + 4.9811 X. R= .945 INCLUDE LOTS J.K.L.P.Q.S.T.U.W
VEL7 = -102.817 + 424.5502 X. R= .937 ALL LOTS LOG FIT.
VEL5 = 765.944 + 4.6756 X. R= .956 ALL LOTS.
VEL5 = 730.556 + 5.0599 X. R= .949 EXCLUDE LOTS R.V.
VEL5 = 621.641 + 6.1412 X. R= .900 EXCLUDE LOTS R.V.Q.U.
VEL5 = 456.523 + 7.7589 X. R= .805 EXCLUDE LOTS R.V.Q.U.P.T.
VEL5 = 715.158 + 5.2639 X. R= .957 INCLUDE LOTS J.K.L.P.Q.S.T.U.W
VEL5 = -792.319 + 440.5188 X. R= .956 ALL LOTS LOG FIT.

Table 44 RQ (9 C, 4-28, 2)

RELATIVE QUICKNESS

	1	2	3	4	5	6	AV	SD
J	116.74	108.20	107.42	106.14	104.45	108.67	108.61	4.27
K	107.01	102.65	103.42	101.76	99.15	103.25	102.88	2.56
L	107.83	99.39	100.23	102.33	98.48	100.57	101.47	3.37
JL	103.04	99.14	99.72	103.84	99.78	103.18	101.45	2.11
JKL	105.29	98.33	98.25	98.88	99.23	104.71	100.78	3.29
JKLL	108.19	96.00	95.91	98.39	94.63	99.04	98.69	4.94
M	94.29	98.34	94.95	96.25	94.57	96.85	95.88	1.56
N	107.16	108.17	102.40	102.90	103.74	105.71	105.01	2.37
P	89.19	92.11	89.76	90.74	88.62	90.67	90.18	1.26
Q	78.47	77.08	77.90	78.96	77.93	77.30	77.94	.70
R	124.86	127.72	124.65	124.54	123.69	130.98	126.07	2.77
S	106.59	109.18	106.88	106.36	103.51	112.61	107.52	3.08
T	84.23	85.54	83.54	83.87	82.21	85.06	84.08	1.18
U	64.96	67.02	66.59	68.48	64.69	68.93	66.78	1.75
V	117.05	118.00	115.75	119.92	124.57	116.68	118.66	3.22
W	101.94	100.65	98.27	100.59	107.24	101.05	101.62	3.01
LL	96.77	91.38	87.44	91.71	94.27	97.70	93.21	3.82

VEL7	=	1486.152	+ 3.6152	X.	R= .928	ALL LOTS.
VEL7	=	1482.893	+ 3.6505	X.	R= .890	EXCLUDE LOTS P,V.
VEL7	=	1508.550	+ 3.3954	X.	R= .699	EXCLUDE LOTS R,V,Q,U.
VEL7	=	1255.938	+ 5.8420	X.	R= .674	EXCLUDE LOTS R,V,Q,U,P,T.
VEL7	=	1456.423	+ 4.0184	X.	R= .928	INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL7	=	303.570	+ 336.0448	X.	R= .924	ALL LOTS LOG FIT.
VEL5	=	859.398	+ 3.7211	X.	R= .939	ALL LOTS.
VEL5	=	833.401	+ 4.0059	X.	R= .922	EXCLUDE LOTS R,V.
VEL5	=	786.864	+ 4.4649	X.	R= .821	EXCLUDE LOTS R,V,Q,U.
VEL5	=	797.577	+ 4.3651	X.	R= .581	EXCLUDE LOTS R,V,Q,U,P,T.
VEL5	=	818.073	+ 4.2132	X.	R= .932	INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL5	=	-364.525	+ 347.3496	X.	R= .939	ALL LOTS LOG FIT.

Table 45 RQA (RC, 4-28, 2)

RELATIVE QUICKNESS BY AVERAGED REFERENCE FIRINGS

	1	2	3	4	5	6	AV	SD
J	104.17	105.23	104.60	104.27	104.94	105.03	104.71	.43
K	100.45	102.43	102.44	101.34	101.40	101.79	101.64	.75
L	100.38	99.72	100.47	101.30	100.71	100.42	100.47	.52
JL	99.83	100.45	100.91	102.49	100.24	100.55	100.75	.92
JKL	100.21	99.92	100.16	99.52	99.83	101.06	100.12	.52
JKLL	98.20	97.61	97.99	99.47	98.78	99.45	98.58	.78
M	94.37	97.18	96.73	97.39	95.37	96.97	96.33	1.20
N	102.07	103.38	102.02	101.67	102.14	102.73	102.34	.61
P	88.39	91.14	91.34	91.67	90.87	92.59	91.00	1.41
Q	80.92	80.13	82.55	81.62	81.86	80.66	81.29	.88
R	118.65	119.41	119.24	119.35	118.48	120.36	119.25	.67
S	107.10	106.84	108.03	107.00	104.32	108.61	106.98	1.48
T	85.59	86.94	87.16	88.28	86.25	89.77	87.33	1.50
U	70.46	72.27	72.66	73.39	71.84	74.16	72.46	1.28
V	114.41	116.85	116.03	116.54	117.26	116.61	116.28	1.00
W	102.51	103.02	101.17	101.60	103.97	104.15	102.74	1.22
LL	92.00	94.22	91.38	94.54	98.37	98.10	94.77	2.95

VEL7 = 1396.921 + 4.5297 X. R= .942 ALL LOTS.
VEL7 = 1389.177 + 4.6143 X. R= .913 EXCLUDE LOTS R.V.
VEL7 = 1379.951 + 4.7037 X. R= .768 EXCLUDE LOTS R.V.Q.U.
VEL7 = 904.762 + 9.3564 X. R= .843 EXCLUDE LOTS R.V.Q.U.P.T.
VEL7 = 1359.952 + 5.0058 X. R= .946 INCLUDE LOTS J.K.L.P.Q.S.T.U.W
VEL7 = -107.107 + 425.5460 X. R= .938 ALL LOTS LOG FIT.
VEL5 = 765.469 + 4.6835 X. R= .958 ALL LOTS.
VEL5 = 728.806 + 5.0818 X. R= .950 EXCLUDE LOTS R.V.
VEL5 = 518.046 + 6.1824 X. R= .903 EXCLUDE LOTS R.V.Q.U.
VEL5 = 455.540 + 7.7760 X. R= .810 EXCLUDE LOTS R.V.Q.U.P.T.
VEL5 = 713.191 + 5.2881 X. R= .958 INCLUDE LOTS J.K.L.P.Q.S.T.U.W
VEL5 = -795.669 + 441.3117 X. R= .957 ALL LOTS LOG FIT.

Table 46 RQA (9 C, 4-28, 2)

RELATIVE QUICKNESS BY AVERAGED REFERENCE FIRINGS

	1	2	3	4	5	6	AV	SD
J	105.95	109.24	109.55	106.44	108.29	107.90	107.90	1.46
K	99.58	103.49	104.97	101.86	102.22	102.75	102.48	1.80
L	100.14	100.14	101.47	102.45	101.42	100.16	100.96	.96
JL	98.94	100.86	101.95	104.64	100.72	100.77	101.32	1.89
JKL	100.77	100.62	100.16	99.51	100.16	102.17	100.47	.93
JKLL	96.66	96.42	96.99	99.62	99.01	100.07	98.13	1.62
M	92.36	97.03	96.22	97.51	94.71	96.79	95.77	1.93
N	104.33	106.53	104.04	104.52	103.93	105.53	104.81	1.02
P	85.54	90.38	90.02	91.73	89.65	93.66	90.16	2.69
Q	77.09	76.71	78.80	78.48	78.88	77.54	77.92	.93
R	125.23	126.10	126.62	126.23	124.36	127.26	125.97	1.03
S	106.84	107.86	108.33	107.77	103.94	109.76	107.42	1.95
T	81.09	84.12	83.73	84.66	83.03	87.55	84.05	2.16
U	64.09	66.86	67.07	68.04	65.39	69.46	66.77	1.82
V	115.47	119.58	117.57	118.60	120.11	119.89	118.54	1.77
W	100.64	101.91	99.77	99.43	103.55	103.72	101.50	1.86
LL	89.29	91.98	88.01	92.70	98.49	98.60	93.18	4.50

VEL7	:	1484.422	+ 3.6406	X.	R= .930	ALL LOTS.
VEL7	=	1478.555	+ 3.7046	X.	R= .893	EXCLUDE LOTS R,V.
VEL7	=	1499.264	+ 3.4978	X.	R= .708	EXCLUDE LOTS R,V,Q,U.
VEL7	=	1234.475	+ 6.0704	X.	R= .692	EXCLUDE LOTS R,V,Q,U,P,T.
VEL7	=	1451.112	+ 4.0846	X.	R= .932	INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL7	=	293.642	+ 338.3648	X.	R= .926	ALL LOTS LOG FIT.
VEL5	=	858.029	+ 3.7431	X.	R= .940	ALL LOTS.
VEL5	=	829.026	+ 4.0613	X.	R= .925	EXCLUDE LOTS R,V.
VEL5	=	776.341	+ 4.5826	X.	R= .829	EXCLUDE LOTS R,V,Q,U.
VEL5	=	775.412	+ 4.5958	X.	R= .605	EXCLUDE LOTS R,V,Q,U,P,T.
VEL5	=	812.824	+ 4.2792	X.	R= .936	INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL5	=	-372.994	+ 349.3567	X.	R= .941	ALL LOTS LOG FIT.
PP 7	=	-5.145	+ .4254	X.	R= .844	ALL LOTS.
PP 7	=	.820	+ .3594	X.	R= .734	EXCLUDE LOTS R,V.
PP 7	=	-8.486	+ .4516	X.	R= .590	EXCLUDE LOTS R,V,Q,U.
PP 7	=	-52.069	+ .8755	X.	R= .612	EXCLUDE LOTS R,V,Q,U,P,T.
PP 7	=	-3.721	+ .4241	X.	R= .828	INCLUDE LOTS J,K,L,P,Q,S,T,U,W
PP 7	=	-139.272	+ 38.4437	X.	R= .817	ALL LOTS LOG FIT.
PP 5	=	.792	+ .1284	X.	R= .868	ALL LOTS.
PP 5	=	1.512	+ .1204	X.	R= .789	EXCLUDE LOTS R,V.
PP 5	=	-2.457	+ .1597	X.	R= .684	EXCLUDE LOTS R,V,Q,U.
PP 5	=	-6.442	+ .1986	X.	R= .510	EXCLUDE LOTS R,V,Q,U,P,T.
PP 5	=	.545	+ .1337	X.	R= .829	INCLUDE LOTS J,K,L,P,Q,S,T,U,W
PP 5	=	-40.249	+ 11.7254	X.	R= .850	ALL LOTS LOG FIT.

TABLE 47. REFERENCE SELF RQ (RC, 4-28,2)

(J-K-L)	100.00	103.49	103.27	103.00	104.98	102.92
(J-K-L)	97.56	100.00	99.61	99.52	101.23	99.66
(J-K-L)	98.11	100.43	100.00	99.93	101.62	100.11
(J-K-L)	98.06	100.50	100.09	100.00	101.72	100.15
(J-K-L)	96.58	98.84	98.41	98.35	100.00	98.52
(J-K-L)	97.78	100.38	100.02	99.90	101.65	100.00
(JL-JKL)	100.00	102.54	102.86	101.99	102.16	100.24
(JL-JKL)	97.89	100.00	100.18	99.47	99.70	97.94
(JL-JKL)	97.85	99.86	100.00	99.33	99.58	97.86
(JL-JKL)	98.40	100.54	100.72	100.00	100.23	98.46
(JL-JKL)	98.13	100.32	100.52	99.78	100.00	98.22
(JL-JKL)	99.86	102.19	102.44	101.65	101.85	100.00
(LL-JKLL)	100.00	108.40	108.66	108.77	111.81	108.33
(LL-JKLL)	93.36	100.00	99.93	100.14	102.58	99.33
(LL-JKLL)	93.67	100.13	100.00	100.23	102.61	99.35
(LL-JKLL)	93.39	99.89	99.78	100.00	102.39	99.14
(LL-JKLL)	91.50	97.65	97.49	97.73	100.00	96.82
(LL-JKLL)	94.56	100.89	100.73	100.97	103.30	100.00
(M-N)	100.00	100.64	101.52	101.47	101.58	101.50
(M-N)	99.39	100.00	100.82	100.77	100.90	100.84
(M-N)	98.77	99.32	100.00	99.98	100.16	100.13
(M-N)	98.79	99.35	100.04	100.00	100.18	100.16
(M-N)	98.56	99.14	99.89	99.84	100.00	99.96
(M-N)	98.58	99.17	99.95	99.91	100.05	100.00
(P-T)	100.00	101.32	102.69	102.75	102.92	104.56
(P-T)	98.72	100.00	101.32	101.38	101.55	103.18
(P-T)	97.49	98.74	100.00	100.05	100.22	101.85
(P-T)	97.46	98.70	99.96	100.00	100.17	101.79
(P-T)	97.30	98.54	99.79	99.84	100.00	101.62
(P-T)	95.75	96.98	98.24	98.27	98.43	100.00
(Q-U)	100.00	101.57	101.76	100.94	101.80	101.66
(Q-U)	98.47	100.00	100.19	99.39	100.25	100.10
(Q-U)	98.32	99.86	100.00	99.22	100.07	99.94
(Q-U)	99.09	100.64	100.80	100.00	100.86	100.72
(Q-U)	98.24	99.79	99.95	99.16	100.00	99.87
(Q-U)	98.37	99.41	100.09	99.29	100.14	100.00
(R-S)	100.00	99.42	101.22	101.40	100.35	98.92
(R-S)	100.59	100.00	101.83	102.00	100.95	99.49
(R-S)	98.80	98.22	100.00	100.18	99.14	97.74
(R-S)	98.63	98.05	99.83	100.00	98.97	97.56
(R-S)	99.65	99.07	100.87	101.04	100.00	98.58
(R-S)	101.15	100.54	102.40	102.55	101.50	100.00
(V-W)	100.00	101.35	101.58	99.13	98.19	102.47
(V-W)	98.75	100.00	100.24	97.83	96.96	101.12
(V-W)	98.51	99.77	100.00	97.60	96.72	100.88
(V-W)	100.94	102.24	102.48	100.00	99.11	103.37
(V-W)	101.84	103.21	103.45	100.95	100.00	104.36
(V-W)	97.65	98.91	99.13	96.74	95.88	100.00

TABLE 48. REFERENCE SELF RQ (9pt, 4-28,2)

(J-K-L)	100.00	109.04	110.34	108.53	112.63	107.15
(J-K-L)	94.43	100.00	100.53	99.33	102.33	98.96
(J-K-L)	94.39	99.57	100.00	98.88	101.76	98.63
(J-K-L)	95.22	100.72	101.23	100.00	103.02	99.71
(J-K-L)	92.94	97.91	98.30	97.21	100.00	97.01
(J-K-L)	95.07	101.18	101.83	100.54	103.69	100.00
(JL-JKL)	100.00	106.40	107.47	105.25	105.40	101.76
(JL-JKL)	95.06	100.00	100.50	98.94	99.24	96.15
(JL-JKL)	95.09	99.69	100.00	98.62	98.99	96.00
(JL-JKL)	96.07	101.08	101.58	100.00	100.31	97.18
(JL-JKL)	95.68	100.79	101.37	99.72	100.00	96.85
(JL-JKL)	98.64	104.24	104.96	103.12	103.37	100.00
(LL-JKLL)	100.00	113.90	116.14	115.72	121.08	117.00
(LL-JKLL)	90.51	100.00	100.94	100.88	104.51	100.92
(LL-JKLL)	90.34	99.27	100.00	100.00	103.41	99.84
(LL-JKLL)	90.18	99.24	100.02	100.00	103.47	99.90
(LL-JKLL)	87.79	96.17	96.78	96.81	100.00	96.54
(LL-JKLL)	91.01	99.65	100.27	100.30	103.60	100.00
(M-N)	100.00	100.80	103.77	103.61	102.30	102.04
(M-N)	99.27	100.00	102.74	102.60	101.40	101.19
(M-N)	97.34	97.90	100.00	99.91	99.03	98.96
(M-N)	97.39	97.97	100.11	100.00	99.11	99.03
(M-N)	98.09	98.74	101.18	101.06	100.00	99.86
(M-N)	98.17	98.86	101.44	101.30	100.18	100.00
(P-T)	100.00	102.51	104.72	105.56	105.76	107.78
(P-T)	97.60	100.00	102.08	102.88	103.05	105.03
(P-T)	95.82	98.11	100.00	100.77	100.90	102.88
(P-T)	95.12	97.38	99.25	100.00	100.12	102.07
(P-T)	95.07	97.31	99.15	99.89	100.00	101.95
(P-T)	93.26	95.46	97.30	98.02	98.12	100.00
(Q-U)	100.00	101.28	103.21	101.23	103.08	102.13
(Q-U)	98.74	100.00	101.90	99.95	101.77	100.84
(Q-U)	97.20	98.44	100.00	98.25	100.04	99.17
(Q-U)	98.87	100.13	101.88	100.00	101.84	100.92
(Q-U)	97.10	98.34	100.06	98.23	100.00	99.12
(Q-U)	97.95	99.20	100.98	99.11	100.91	100.00
(R-S)	100.00	98.59	101.21	101.08	100.25	97.39
(R-S)	101.50	100.00	102.74	102.57	101.74	98.74
(R-S)	98.84	97.45	100.00	99.90	99.07	96.32
(R-S)	98.95	97.53	100.14	100.00	99.19	96.34
(R-S)	99.77	98.35	100.96	100.83	100.00	97.17
(R-S)	102.99	101.41	104.31	104.07	103.26	100.00
(V-W)	100.00	103.15	103.51	100.67	97.98	104.62
(V-W)	97.22	100.00	100.30	97.60	95.22	101.36
(V-W)	96.95	99.71	100.00	97.32	94.96	101.06
(V-W)	99.62	102.50	102.80	100.00	97.58	103.89
(V-W)	102.08	105.30	105.63	102.74	100.00	106.77
(V-W)	95.96	98.68	98.96	96.31	94.00	100.00

Table 49 AQ (RC, 4-28, 1)

PRESSURE RANGE 4 TO 28, DELTA KPSI= 1

ABSOLUTE QUICKNESS (PSI/MICROSEC)

	1	2	3	4	5	6	AV	SD
J	15.281	15.450	15.390	15.312	15.397	15.435	15.378	.067
K	14.974	15.232	15.279	15.108	15.124	15.167	15.147	.107
L	14.949	14.882	15.009	15.085	14.992	14.962	14.980	.068
JL	15.038	15.131	15.208	15.412	15.114	15.182	15.181	.128
JKL	15.154	15.074	15.129	15.032	15.084	15.280	15.125	.087
JKLL	14.697	14.600	14.656	14.890	14.803	14.890	14.756	.123
M	14.145	14.564	14.502	14.594	14.291	14.537	14.439	.180
N	15.519	15.698	15.516	15.502	15.487	15.642	15.558	.084
P	13.591	14.051	14.038	14.101	14.001	14.293	14.013	.231
Q	12.628	12.521	12.884	12.727	12.797	12.622	12.697	.132
R	18.777	18.862	18.891	18.876	18.725	19.018	18.858	.101
S	16.702	16.765	16.861	16.773	16.320	16.974	16.723	.223
T	13.022	13.338	13.377	13.457	13.234	13.760	13.365	.245
U	10.914	11.229	11.265	11.397	11.103	11.505	11.236	.210
V	17.891	18.299	18.093	18.218	18.332	18.271	18.184	.166
W	15.945	16.065	15.774	15.812	16.230	16.245	16.012	.203
LL	13.964	14.237	13.873	14.272	14.740	14.716	14.300	.365
(J-K-L)	14.501	14.910	14.854	14.858	15.061	14.816	14.833	.184
(JL-JKL)	14.820	15.158	15.203	15.081	15.101	14.826	15.031	.167
(LL-JKLL)	14.089	14.995	14.987	15.017	15.353	14.875	14.886	.423
(M-N)	15.135	15.218	15.346	15.291	15.337	15.348	15.279	.086
(P-T)	15.029	15.255	15.503	15.515	15.501	15.742	15.421	.242
(Q-U)	15.588	15.763	15.844	15.720	15.873	15.819	15.768	.104
(R-S)	15.739	15.673	15.928	15.947	15.826	15.554	15.778	.152
(V-W)	15.666	15.954	15.954	15.616	15.414	16.079	15.780	.255
(6-HEX)	11.078	20.643	15.519	15.827	15.960	15.952	0.000	0.000

VEL7 = 1411.322 + 28.7063 X. R= .954 ALL LOTS.
VEL7 = 1346.357 + 33.3014 X. R= .949 EXCLUDE LOTS R,V.
VEL7 = 1341.825 + 33.5908 X. R= .867 EXCLUDE LOTS R,V,Q,U.
VEL7 = 1160.304 + 45.2598 X. R= .882 EXCLUDE LOTS R,V,Q,U,P,T.
VEL7 = 1319.446 + 35.6060 X. R= .977 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL7 = 682.075 + 429.4685 X. R= .959 ALL LOTS LOG FIT.
VEL5 = 786.517 + 29.2731 X. R= .958 ALL LOTS.
VEL5 = 686.610 + 36.3358 X. R= .978 EXCLUDE LOTS R,V.
VEL5 = 604.580 + 41.7166 X. R= .963 EXCLUDE LOTS R,V,Q,U.
VEL5 = 608.048 + 41.5194 X. R= .935 EXCLUDE LOTS R,V,Q,U,P,T.
VEL5 = 671.421 + 37.5420 X. R= .987 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL5 = 38.159 + 439.6892 X. R= .967 ALL LOTS LOG FIT.

Table 50 AQ (9 C, 4-28, 1)

PRESSURE RANGE 4 TO 28. DELTA KPSI= 1

ABSOLUTE QUICKNESS (PSI/MICROSEC)

	1	2	3	4	5	6	AV	SD
J	3.615	3.683	3.685	3.627	3.663	3.664	3.656	.029
K	3.512	3.605	3.636	3.562	3.574	3.587	3.579	.042
L	3.502	3.498	3.540	3.559	3.532	3.517	3.525	.023
JL	3.532	3.570	3.601	3.670	3.565	3.584	3.587	.047
JKL	3.586	3.551	3.570	3.544	3.557	3.621	3.571	.028
JKLL	3.417	3.400	3.415	3.485	3.466	3.494	3.446	.041
M	3.251	3.371	3.355	3.383	3.295	3.367	3.337	.052
N	3.683	3.734	3.680	3.692	3.664	3.715	3.695	.026
P	3.182	3.350	3.338	3.365	3.320	3.456	3.335	.089
Q	2.957	2.927	3.024	2.997	3.014	2.964	2.980	.037
R	4.773	4.799	4.831	4.812	4.748	4.846	4.802	.037
S	4.024	4.055	4.089	4.077	3.926	4.138	4.051	.072
T	3.004	3.118	3.118	3.132	3.086	3.239	3.116	.076
U	2.466	2.556	2.558	2.600	2.512	2.634	2.554	.060
V	4.379	4.530	4.430	4.502	4.556	4.544	4.490	.071
W	3.814	3.854	3.771	3.761	3.917	3.914	3.839	.068
LL	3.233	3.305	3.217	3.314	3.449	3.453	3.328	.102
(J-K-L)	3.369	3.500	3.500	3.485	3.553	3.465	3.477	.065
(JL-JKL)	3.451	3.582	3.603	3.562	3.560	3.472	3.538	.062
(LL-JKLL)	3.248	3.497	3.503	3.509	3.609	3.487	3.475	.120
(M-N)	3.556	3.580	3.647	3.628	3.625	3.620	3.609	.034
(P-T)	3.556	3.639	3.726	3.739	3.738	3.794	3.698	.086
(Q-U)	3.766	3.814	3.880	3.819	3.865	3.840	3.831	.041
(R-S)	3.832	3.800	3.892	3.883	3.866	3.737	3.835	.059
(V-W)	3.770	3.895	3.902	3.797	3.706	3.938	3.835	.091
(6-HEX)	2.511	4.979	3.729	3.830	3.682	3.379	0.000	0.000

VEL7 = 1490.060 + 98.6212 X. R= .945 ALL LOTS.
VEL7 = 1397.313 + 126.3734 X. R= .957 EXCLUDE LOTS R,V.
VEL7 = 1407.673 + 123.5176 X. R= .888 EXCLUDE LOTS R,V,Q,U.
VEL7 = 1326.579 + 145.3830 X. R= .877 EXCLUDE LOTS R,V,Q,U,P,T.
VEL7 = 1374.991 + 134.2426 X. R= .983 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL7 = 1386.258 + 361.1728 X. R= .959 ALL LOTS LOG FIT.
VEL5 = 871.879 + 99.1593 X. R= .935 ALL LOTS.
VEL5 = 748.556 + 136.0477 X. R= .973 EXCLUDE LOTS R,V.
VEL5 = 708.794 + 147.0977 X. R= .946 EXCLUDE LOTS R,V,Q,U.
VEL5 = 762.163 + 132.9336 X. R= .927 EXCLUDE LOTS R,V,Q,U,P,T.
VEL5 = 733.873 + 140.4039 X. R= .985 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL5 = 765.030 + 365.0982 X. R= .954 ALL LOTS LOG FIT.

Table 51 RQ (RC, 4-28, 1)

RELATIVE QUICKNESS

	1	2	3	4	5	6	AV	SD
J	105.82	103.81	103.59	103.54	102.54	104.19	103.91	1.08
K	102.64	101.58	102.15	101.36	99.86	101.59	101.53	.94
L	102.65	99.44	100.78	101.36	99.27	100.35	100.64	1.26
JL	100.97	99.80	99.96	101.88	99.80	101.90	100.72	1.01
JKL	101.35	99.35	99.50	99.38	99.43	102.41	100.24	1.32
JKLL	104.33	96.97	97.50	98.58	96.00	99.66	98.84	2.97
M	94.92	97.38	96.48	97.33	95.04	96.49	96.27	1.07
N	102.52	103.10	101.42	101.27	101.37	101.94	101.94	.74
P	90.31	91.88	90.66	91.29	90.48	90.29	90.82	.64
Q	81.58	79.90	82.17	81.69	81.23	80.37	81.16	.86
R	118.72	120.09	118.18	117.84	118.15	121.65	119.11	1.48
S	107.43	107.75	107.14	105.97	104.42	109.94	107.11	1.85
T	87.26	87.72	87.03	87.97	86.01	87.93	87.32	.74
U	71.94	72.32	72.81	73.88	71.84	73.95	72.79	.94
V	114.83	115.91	115.04	117.89	119.63	114.48	116.30	2.04
W	102.83	102.39	100.43	103.22	106.48	102.46	102.97	1.97
LL	98.30	94.49	92.58	94.67	95.72	98.52	95.71	2.32

VEL7 = 1394.976 + 4.5512 X. R= .941 ALL LOTS.
VEL7 = 1386.223 + 4.6467 X. R= .912 EXCLUDE LOTS R,V.
VEL7 = 1378.314 + 4.7229 X. R= .768 EXCLUDE LOTS R,V,Q,U.
VEL7 = 862.557 + 9.7770 X. R= .857 EXCLUDE LOTS R,V,Q,U,P,T.
VEL7 = 1356.529 + 5.0443 X. R= .946 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL7 = -118.809 + 428.1258 X. R= .937 ALL LOTS LOG FIT.
VEL5 = 761.860 + 4.7219 X. R= .961 ALL LOTS.
VEL5 = 722.815 + 5.1459 X. R= .954 EXCLUDE LOTS R,V.
VEL5 = 606.810 + 6.2901 X. R= .916 EXCLUDE LOTS R,V,Q,U.
VEL5 = 389.998 + 8.4260 X. R= .853 EXCLUDE LOTS R,V,Q,U,P,T.
VEL5 = 706.922 + 5.3569 X. R= .963 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL5 = -814.633 + 445.4760 X. R= .960 ALL LOTS LOG FIT.
PP 7 = -16.346 + .5304 X. R= .867 ALL LOTS.
PP 7 = -9.451 + .4645 X. R= .772 EXCLUDE LOTS R,V.
PP 7 = -27.911 + .6481 X. R= .681 EXCLUDE LOTS R,V,Q,U.
PP 7 = -118.648 + 1.5376 X. R= .826 EXCLUDE LOTS R,V,Q,U,P,T.
PP 7 = -14.694 + .5359 X. R= .860 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
PP 7 = -190.490 + 49.5918 X. R= .844 ALL LOTS LOG FIT.
PP 5 = -2.669 + .1636 X. R= .896 ALL LOTS.
PP 5 = -1.987 + .1562 X. R= .833 EXCLUDE LOTS R,V.
PP 5 = -9.405 + .2300 X. R= .701 EXCLUDE LOTS R,V,Q,U.
PP 5 = -25.893 + .3917 X. R= .774 EXCLUDE LOTS R,V,Q,U,P,T.
PP 5 = -3.080 + .1708 X. R= .870 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
PP 5 = -56.039 + 15.1624 X. R= .879 ALL LOTS LOG FIT.

Table 52 RQ (9 C, 4-28, 1)

RELATIVE QUICKNESS

	1	2	3	4	5	6	AV	SD
J	112.74	106.79	106.18	105.28	103.76	107.35	107.02	3.07
K	105.84	102.67	103.28	101.85	99.68	103.15	102.74	2.01
L	106.18	99.72	100.74	102.09	98.92	101.06	101.45	2.56
JL	102.53	99.51	99.82	103.23	99.84	102.95	101.31	1.76
JKL	104.29	98.82	98.69	99.05	99.41	104.21	100.74	2.73
JKLL	106.79	96.50	96.39	98.69	95.22	99.58	98.86	4.20
M	93.82	97.26	94.41	95.95	93.62	96.19	95.21	1.47
N	105.58	106.20	101.77	102.65	102.80	104.42	103.91	1.77
P	89.01	91.87	89.53	90.32	88.77	90.20	89.95	1.13
Q	78.58	76.94	78.37	78.80	78.09	77.39	78.03	.72
R	124.66	126.78	124.50	123.78	122.89	129.88	125.42	2.54
S	106.88	108.59	107.17	106.25	103.29	112.08	107.38	2.89
T	84.40	85.47	83.84	84.21	82.64	85.17	84.29	1.01
U	65.92	67.30	66.91	68.61	65.66	68.98	67.23	1.36
V	117.04	117.75	115.87	120.08	124.05	116.51	118.55	3.06
W	101.96	100.68	98.40	101.09	107.02	100.88	101.67	2.87
LL	98.15	92.77	89.56	93.10	94.73	98.35	94.44	3.39

VEL7	=	1479.904 +	3.6871 X.	R= .929	ALL LOTS.
VEL7	=	1473.826 +	3.7537 X.	R= .892	EXCLUDE LOTS R.V.
VEL7	=	1494.370 +	3.5482 X.	R= .705	EXCLUDE LOTS R.V.Q.U.
VEL7	=	1192.196 +	6.4874 X.	R= .700	EXCLUDE LOTS R.V.Q.U.P.T.
VEL7	=	1446.917 +	4.1266 X.	R= .930	INCLUDE LOTS J.K.L.P.Q.S.T.U.W
VEL7	=	272.779 +	342.9123 X.	R= .925	ALL LOTS LOG FIT.
VEL5	=	851.804 +	3.8069 X.	R= .944	ALL LOTS.
VEL5	=	821.253 +	4.1421 X.	R= .930	EXCLUDE LOTS R.V.
VEL5	=	759.822 +	4.7501 X.	R= .844	EXCLUDE LOTS R.V.Q.U.
VEL5	=	716.650 +	5.1738 X.	R= .645	EXCLUDE LOTS R.V.Q.U.P.T.
VEL5	=	805.871 +	4.3506 X.	R= .939	INCLUDE LOTS J.K.L.P.Q.S.T.U.W
VEL5	=	-400.889 +	355.4379 X.	R= .944	ALL LOTS LOG FIT.

Table 53 AREA P-T (RC, 10 to 90% PP)

AREA P-T CURVE(PSI-SEC) FROM .10 TO .90 PP.

	1	2	3	4	5	6	AV	SD
J	88.17	89.54	90.17	89.78	91.02	89.80	89.75	.93
K	87.12	87.50	87.12	87.56	89.58	87.83	87.79	.92
L	90.29	91.84	89.01	89.73	88.15	86.45	89.24	1.85
JL	90.57	87.67	90.88	88.53	89.64	90.15	89.67	1.32
JKL	86.92	87.35	87.66	90.41	89.90	90.69	88.82	1.69
JKLL	86.08	90.82	87.81	90.24	87.93	89.54	88.74	1.78
M	97.65	96.18	96.28	93.99	95.18	95.95	95.87	1.22
N	89.91	87.88	89.11	88.24	88.69	86.65	88.41	1.12
P	105.34	102.68	102.19	102.69	103.56	106.33	103.80	1.67
Q	116.11	115.87	115.39	117.28	115.72	117.85	116.37	.97
R	76.45	76.34	76.88	75.45	76.96	77.35	76.57	.66
S	86.72	88.22	84.50	86.54	86.27	83.49	85.95	1.70
T	105.04	104.59	103.43	103.79	106.20	103.84	104.48	1.03
U	122.02	122.02	119.71	120.91	120.13	122.12	121.15	1.06
V	76.08	74.28	74.91	76.60	75.49	75.05	75.40	.84
W	85.70	85.75	89.18	86.95	84.87	85.47	86.32	1.55
LL	89.12	87.35	90.28	88.55	90.80	89.97	89.34	1.27
(J-K-L)	90.29	87.95	91.16	91.05	90.27	87.95	89.78	1.46
(JL-JKL)	89.71	90.72	90.13	88.94	90.75	90.22	90.08	.68
(LL-JKLL)	90.70	86.82	89.31	88.49	83.64	87.84	87.80	2.43
(M-N)	86.77	86.09	86.80	87.46	86.52	88.01	86.94	.69
(P-T)	91.10	93.31	89.57	93.49	91.25	89.33	91.34	1.78
(Q-U)	91.48	90.33	91.39	89.96	92.08	90.96	91.03	.79
(R-S)	90.84	91.35	92.97	92.23	90.29	88.71	91.06	1.50
(V-W)	92.33	91.42	89.80	94.52	91.35	92.68	92.02	1.58
(6-HEX)	120.83	68.71	91.62	88.51	91.65	89.13	0.00	0.00

VEL7 = 2214.974 + -3.9786 X. R=-.869 ALL LOTS.
VEL7 = 2181.351 + -3.6489 X. R=-.848 EXCLUDE LOTS R,V.
VEL7 = 2140.109 + -3.1946 X. R=-.597 EXCLUDE LOTS R,V,Q,U.
VEL7 = 2432.383 + -6.4933 X. R=-.530 EXCLUDE LOTS R,V,Q,U,P,T.
VEL7 = 2243.895 + -4.1899 X. R=-.903 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL7 = 3600.856 +-388.0889 X. R=-.894 ALL LOTS LOG FIT.
VEL5 = 1628.039 + -4.2937 X. R=-.944 ALL LOTS.
VEL5 = 1620.082 + -4.2159 X. R=-.925 EXCLUDE LOTS R,V.
VEL5 = 1698.518 + -5.0873 X. R=-.850 EXCLUDE LOTS R,V,Q,U.
VEL5 = 1884.284 + -7.1837 X. R=-.677 EXCLUDE LOTS R,V,Q,U,P,T.
VEL5 = 1661.854 + -4.5775 X. R=-.945 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL5 = 3119.457 +-417.8910 X. R=-.947 ALL LOTS LOG FIT.

Table 54 AREA P-T (9 C, 10 to 90% PP)

AREA P-T CURVE (PSI-SEC) FROM .10 TO .90 PP.

	1	2	3	4	5	6	AV	SD
J	91.94	92.44	93.82	92.17	92.70	92.11	92.53	.69
K	90.33	90.64	91.10	90.60	91.14	90.75	90.76	.31
L	90.41	91.59	91.07	90.71	91.35	90.63	90.96	.45
JL	90.62	91.04	91.53	91.43	91.46	90.90	91.10	.45
JKL	90.72	91.19	90.43	91.08	90.97	90.72	90.85	.28
JKLL	89.55	90.82	90.69	90.20	90.88	90.16	90.38	.51
M	98.59	97.17	97.34	97.55	98.32	97.83	97.80	.56
N	90.80	89.85	90.77	91.79	92.49	90.48	91.03	.95
P	106.76	106.42	105.79	106.07	105.44	107.07	106.26	.61
Q	118.90	119.66	117.09	119.60	118.46	119.78	118.92	1.03
R	79.45	79.31	79.84	79.13	79.50	78.25	79.25	.54
S	87.45	88.65	88.02	88.66	89.09	87.54	88.24	.67
T	107.61	108.23	107.01	105.82	108.03	105.64	107.06	1.11
U	122.76	125.13	123.43	123.70	122.74	123.09	123.61	.88
V	78.71	78.29	78.36	78.37	78.76	79.05	78.59	.30
W	88.84	88.20	89.36	88.42	88.39	87.83	88.51	.53
LL	92.36	90.67	91.15	91.19	90.52	90.68	91.09	.68
(J-K-L)	90.41	91.30	92.95	92.73	91.33	91.19	91.65	.98
(JL-JKL)	90.64	90.83	92.38	91.55	90.9?	92.09	91.41	.71
(LL-JKLL)	92.40	88.90	89.50	89.13	87.85	91.50	89.88	1.72
(M-N)	89.37	89.21	90.63	91.03	89.55	89.70	89.75	.89
(P-T)	94.87	93.80	93.42	93.65	94.25	93.04	93.84	.65
(Q-U)	93.86	92.53	94.52	93.85	92.72	93.08	93.42	.77
(R-S)	94.66	93.70	93.72	92.91	93.78	92.86	93.66	.66
(V-W)	92.70	93.41	93.39	95.22	94.25	93.00	93.66	.92
(6-HEX)	124.25	71.06	94.54	91.94	92.25	91.63	0.00	0.00

VEL7 = 2221.256 + -3.9469 X. R=-.881 ALL LOTS.
VEL7 = 2181.974 + -3.5709 X. R=-.839 EXCLUDE LOTS R,V.
VEL7 = 2130.295 + -3.0145 X. R=-.575 EXCLUDE LOTS R,V,Q,U.
VEL7 = 2395.361 + -5.9338 X. R=-.469 EXCLUDE LOTS R,V,Q,U,P,T.
VEL7 = 2250.995 + -4.1588 X. R=-.900 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL7 = 3648.519 +-396.4044 X. R=-.886 ALL LOTS LOG FIT.
VEL5 = 1637.393 + -4.2863 X. R=-.942 ALL LOTS.
VEL5 = 1623.514 + -4.1536 X. R=-.922 EXCLUDE LOTS R,V.
VEL5 = 1697.271 + -4.9536 X. R=-.841 EXCLUDE LOTS R,V,Q,U.
VEL5 = 1896.548 + -7.1481 X. R=-.652 EXCLUDE LOTS R,V,Q,U,P,T.
VEL5 = 1671.372 + -4.5610 X. R=-.946 INCLUDE LOTS J,K,L,P,Q,S,T,U,W
VEL5 = 3184.460 +-429.8515 X. R=-.946 ALL LOTS LOG FIT.

Table 55 Peak Pressure and RF (Picatinny)

PEAK PRESSURE (KPSI)

	1	2	3	AV	SD
J	32.05	31.89	31.57	31.84	.24
L	31.69	31.45	31.56	31.56	.13
R	31.48	31.75	31.24	31.49	.25
S	31.08	30.59	30.24	30.64	.42
V	30.58	30.22	29.87	30.22	.35
W	29.71	29.37	29.02	29.37	.34
P	31.11	30.9	31.14	31.06	.12
Q	30.87	30.67	30.16	30.57	.37
T	30.18	29.88	29.79	29.95	.20
U	29.16	28.86	28.71	28.91	.23
K	31.66	31.59	31.76	31.67	.08
(R-S-V-W)	31.29	31.14	30.94	31.12	.18
(P-Q-T-U)	31.05	30.60	30.33	30.66	.37

RELATIVE FORCE

	1	2	3	AV	SD
J	101.22	100.96	99.41	100.53	.98
L	100.07	99.49	99.37	99.64	.38
R	100.62	101.94	100.98	101.18	.68
S	99.34	98.21	97.76	98.44	.82
V	97.72	97.02	96.54	97.10	.59
W	94.94	94.32	93.81	94.36	.57
P	100.19	101.05	102.67	101.30	1.26
Q	99.40	100.26	99.42	99.69	.49
T	97.18	97.67	98.23	97.69	.52
U	93.90	94.32	94.65	94.29	.38

VEL7 = 1843.119 + .0694 X. R= .029 LOTS J,K,L,P,Q,R,S,T,U,V,W.
VEL5 = 1237.270 + -.0938 X. R=-.038 LOTS J,K,L,P,Q,R,S,T,U,V,W.
PP 7 = 35.772 + .0277 X. R= .092 LOTS J,K,L,P,Q,R,S,T,U,V,W.
PP 5 = 13.398 + .0034 X. R= .038 LOTS J,K,L,P,Q,R,S,T,U,V,W.

Table 56 AREA DP/DT vs P (Picatinny)

AREA DP/DT VS P CURVE(KPSI-KPSI)/(MS)

	1	2	3	AV	SD
J	114.13	110.66	108.66	111.15	2.77
L	112.19	107.25	110.99	110.14	2.58
R	128.94	134.00	128.12	130.35	3.18
S	109.45	105.84	104.62	106.63	2.51
V	118.82	117.22	113.76	116.60	2.59
W	94.89	93.93	91.97	93.60	1.49
P	93.39	92.67	92.89	92.98	.37
Q	79.62	79.15	75.74	78.17	2.12
T	83.99	81.50	80.24	81.91	1.91
U	65.13	64.11	62.54	63.93	1.30
K	110.63	110.53	111.84	111.00	.73
(R-S-V-W)	110.23	108.69	107.11	108.68	1.56
(P-Q-T-U)	108.21	103.50	101.43	104.38	3.47

VEL7 = 1544.649 + 3.0569 X. R= .867 LOTS J,K,L,P,Q,R,S,T,U,V,W.
VEL5 = 915.376 + 3.1448 X. R= .873 LOTS J,K,L,P,Q,R,S,T,U,V,W.
PP 7 = 4.111 + .3426 X. R= .779 LOTS J,K,L,P,Q,R,S,T,U,V,W.
PP 5 = 3.251 + .1049 X. R= .790 LOTS J,K,L,P,Q,R,S,T,U,V,W.

Table 57 AQ (8-20, 4) (Picatinny)

PRESSURE RANGE 8 TO 20, DELTA KPSI= 4

ABSOLUTE QUICKNESS (PSI/MICROSEC)

	1	2	3	AV	SD
J	3.646	3.593	3.575	3.605	.037
L	3.702	3.625	3.707	3.678	.046
R	4.422	4.495	4.498	4.472	.043
S	3.950	3.926	3.986	3.954	.031
V	4.312	4.298	4.330	4.313	.016
W	3.617	3.667	3.680	3.655	.033
P	3.230	3.229	3.200	3.219	.017
Q	2.776	2.812	2.786	2.791	.019
T	3.066	3.041	2.990	3.032	.039
U	2.491	2.507	2.476	2.491	.015
K	3.599	3.674	3.634	3.636	.038
(R-S-V-W)	3.782	3.783	3.814	3.793	.018
(P-Q-T-U)	3.770	3.739	3.723	3.744	.024

VEL7 = 1472.374 + 106.7505 X. R= .947 LOTS J,K,L,P,Q,R,S,T,U,V,W.
VEL5 = 937.701 + 110.7613 X. R= .961 LOTS J,K,L,P,Q,R,S,T,U,V,W.
PP 7 = -7.316 + 12.9075 X. R= .917 LOTS J,K,L,P,Q,R,S,T,U,V,W.
PP 5 = -.192 + 3.9350 X. R= .927 LOTS J,K,L,P,Q,R,S,T,U,V,W.

Table 58 RQ (8-20, 4) (Picatinny)

REFERENCE K COMPARED WITH SELF IN 3 LOTS OF 3 FIRINGS EACH

K	100.00	102.19	101.05
K	97.87	100.00	98.88
K	98.97	101.13	100.00
(R-S-V-W)	100.00	100.16	100.93
(R-S-V-W)	99.84	100.00	100.77
(R-S-V-W)	99.08	99.24	100.00
(P-Q-T-U)	100.00	99.44	98.90
(P-Q-T-U)	100.56	100.00	99.46
(P-Q-T-U)	101.11	100.55	100.00

RELATIVE QUICKNESS

	1	2	3	AV	SD
J	101.65	97.92	98.55	99.37	2.00
L	102.87	99.46	102.92	101.75	1.98
R	117.63	119.30	118.53	118.49	.84
S	105.75	105.12	105.58	105.48	.33
V	115.18	115.02	114.51	114.90	.35
W	96.90	98.18	97.55	97.55	.64
P	86.29	86.85	86.21	86.45	.35
Q	74.18	75.74	75.64	75.19	.87
T	81.88	81.66	80.92	81.49	.50
U	66.27	67.12	66.60	66.66	.43

VEL7 = 1469.203 + 4.0141 X. R= .940 LOTS J, L,P,Q,R,S,T,U,V,W.
VEL5 = 832.755 + 4.1693 X. R= .956 LOTS J, L,P,Q,R,S,T,U,V,W.
PP 7 = -7.055 + .4807 X. R= .905 LOTS J, L,P,Q,R,S,T,U,V,W.
PP 5 = -.164 + .1466 X. R= .912 LOTS J, L,P,Q,R,S,T,U,V,W.

RELATIVE QUICKNESS BY AVERAGED REFERENCE FIRINGS

	1	2	3	AV	SD
J	100.58	98.99	98.52	99.36	1.08
L	101.77	100.56	102.89	101.74	1.17
R	117.20	119.06	119.20	118.49	1.12
S	105.36	104.92	106.17	105.48	.64
V	114.75	114.80	115.15	114.90	.22
W	96.54	98.00	98.10	97.55	.87
P	86.76	86.85	85.74	86.45	.62
Q	74.59	75.75	75.22	75.18	.58
T	82.33	81.66	80.48	81.49	.94
U	66.63	67.12	66.23	66.66	.45

VEL7 = 1469.183 + 4.0144 X. R= .940 LOTS J, L,P,Q,R,S,T,U,V,W.
VEL5 = 832.744 + 4.1696 X. R= .956 LOTS J, L,P,Q,R,S,T,U,V,W.
PP 7 = -7.060 + .4808 X. R= .905 LOTS J, L,P,Q,R,S,T,U,V,W.
PP 5 = -.165 + .1467 X. R= .912 LOTS J, L,P,Q,R,S,T,U,V,W.

Table 59 AQ, RQ (8-20, 1) (Picatinny)

PRESSURE RANGE 8 TO 20, DELTA KPSI= 1

ABSOLUTE QUICKNESS (KPSI/MICROSEC)

	1	2	3	AV	SD
J	3.668	3.585	3.575	3.609	.051
L	3.680	3.621	3.704	3.669	.043
R	4.414	4.484	4.497	4.465	.045
S	3.960	3.922	3.992	3.958	.035
V	4.292	4.277	4.318	4.296	.021
W	3.594	3.639	3.654	3.629	.031
P	3.224	3.224	3.196	3.214	.016
Q	2.763	2.793	2.773	2.777	.015
T	3.050	3.024	3.001	3.025	.024
U	2.467	2.492	2.459	2.473	.017
K	3.597	3.669	3.616	3.627	.037
(R-S-V-W)	3.769	3.772	3.795	3.779	.014
(P-Q-T-U)	3.761	3.729	3.713	3.734	.024

VEL7 = 1473.964 + 106.5866 X. R= .949 LOTS J,K,L,P,Q,R,S,T,U,V,W.
VEL5 = 839.949 + 110.4213 X. R= .962 LOTS J,K,L,P,Q,R,S,T,U,V,W.
PP 7 = -7.039 + 12.8636 X. R= .917 LOTS J,K,L,P,Q,R,S,T,U,V,W.
PP 5 = -.102 + 3.9200 X. R= .927 LOTS J,K,L,P,Q,R,S,T,U,V,W.

REFERENCE K COMPARED WITH SELF IN 3 LOTS OF 3 FIRINGS EACH

K	100.00	102.06	100.85
K	98.00	100.00	98.81
K	99.20	101.22	100.00
(R-S-V-W)	100.00	100.15	100.69
(R-S-V-W)	99.86	100.00	100.54
(R-S-V-W)	99.32	99.46	100.00
(P-Q-T-U)	100.00	99.25	98.83
(P-Q-T-U)	100.76	100.00	99.58
(P-Q-T-U)	101.19	100.43	100.00

RELATIVE QUICKNESS

	1	2	3	AV	SD
J	102.81	97.87	98.78	99.82	2.63
L	102.45	99.39	102.90	101.58	1.91
R	117.69	119.36	119.09	118.72	.90
S	105.92	104.85	105.97	105.58	.63
V	114.69	114.37	114.51	114.53	.16
W	96.14	97.28	96.99	96.81	.59
P	86.21	86.92	86.35	86.49	.38
Q	73.95	75.41	75.26	74.87	.80
T	81.46	81.34	81.12	81.30	.17
U	65.70	66.91	66.25	66.29	.61

VEL7 = 1471.957 + 3.9909 X. R= .940 LOTS J, L,P,Q,R,S,T,U,V,W.
VEL5 = 836.574 + 4.1349 X. R= .955 LOTS J, L,P,Q,R,S,T,U,V,W.

Table 60 RQ (4-28, 2) (Picatinny)

REFERENCE K COMPARED WITH SELF IN 3 LOTS OF 3 FIRINGS EACH

K	100.00	101.15	100.69
K	98.91	100.00	99.58
K	99.33	100.46	100.00
(R-S-V-W)	100.00	99.29	98.87
(R-S-V-W)	100.73	100.00	99.55
(R-S-V-W)	101.27	100.51	100.00
(P-Q-T-U)	100.00	97.88	96.49
(P-Q-T-U)	102.31	100.00	98.52
(P-Q-T-U)	103.97	101.55	100.00

RELATIVE QUICKNESS

	1	2	3	AV	SD
J	102.49	99.01	99.04	100.18	2.00
L	101.51	98.35	101.09	100.31	1.71
R	117.20	120.95	119.48	119.21	1.89
S	103.21	102.26	101.77	102.41	.73
V	112.73	112.85	110.97	112.19	1.05
W	93.25	93.77	92.67	93.03	.87
P	86.69	88.46	89.12	88.09	1.26
Q	74.45	76.63	76.03	75.70	1.13
T	80.70	80.39	80.95	80.68	.28
U	64.24	64.76	63.76	64.26	.50

VEL7 = 1475.797 + 3.9920 X. R= .929 LOTS J. L,P,Q,R,S,T,U,V,W.
VEL5 = 846.675 + 4.0708 X. R= .928 LOTS J. L,P,Q,R,S,T,U,V,W.
PP 7 = -5.382 + .4686 X. R= .877 LOTS J. L,P,Q,R,S,T,U,V,W.
PP 5 = .479 + .1415 X. R= .875 LOTS J. L,P,Q,R,S,T,U,V,W.

RELATIVE QUICKNESS BY AVERAGED REFERENCE FIRINGS

	1	2	3	AV	SD
J	101.87	99.52	99.10	100.16	1.49
L	100.87	98.88	101.16	100.30	1.24
R	117.95	120.85	118.80	119.20	1.49
S	103.79	102.13	101.37	102.43	1.24
V	113.35	112.71	110.56	112.20	1.46
W	93.66	93.61	91.89	93.05	1.01
P	88.44	88.20	87.41	88.02	.54
Q	75.90	76.44	74.76	75.70	.86
T	82.16	80.20	79.65	80.67	1.32
U	65.23	64.67	62.92	64.27	1.21

VEL7 = 1475.772 + 3.9925 X. R= .929 LOTS J. L,P,Q,R,S,T,U,V,W.
VEL5 = 846.558 + 4.0723 X. R= .928 LOTS J. L,P,Q,R,S,T,U,V,W.
PP 7 = -5.400 + .4688 X. R= .877 LOTS J. L,P,Q,R,S,T,U,V,W.
PP 5 = .472 + .1416 X. R= .875 LOTS J. L,P,Q,R,S,T,U,V,W.

Table 61 AQ (4-28, 2) (Picatinny)

PRESSURE RANGE 4 TO 28. DELTA KPSI= 2

ABSOLUTE QUICKNESS (PSI/MICROSEC)

	1	2	3	AV	SD
J	4.012	3.926	3.894	3.944	.061
L	4.013	3.899	3.993	3.968	.061
R	4.673	4.797	4.687	4.719	.068
S	4.022	3.943	3.918	3.961	.054
V	4.418	4.369	4.286	4.358	.067
W	3.589	3.559	3.495	3.548	.048
P	3.411	3.400	3.386	3.399	.013
Q	2.918	2.923	2.836	2.893	.049
T	3.146	3.069	3.028	3.081	.060
U	2.472	2.435	2.374	2.427	.049
K	3.959	3.987	3.983	3.976	.015
(R-S-V-W)	4.011	3.980	3.945	3.979	.033
(P-Q-T-U)	3.962	3.847	3.792	3.867	.087

VEL7 = 1512.438 + 92.0234 X. R= .900 LOTS J,K,L,P,Q,R,S,T,U,V,W.
VEL5 = 881.393 + 94.9010 X. R= .908 LOTS J,K,L,P,Q,R,S,T,U,V,W.
PP 7 = -.415 + 10.5649 X. R= .828 LOTS J,K,L,P,Q,R,S,T,U,V,W.
PP 5 = 1.882 + 3.2289 X. R= .838 LOTS J,K,L,P,Q,R,S,T,U,V,W.

Table 62 AREA P-T (10 to 90% PP) (Picatinny)

AREA P-T CURVE(PSI-SEC) FROM .10 TO .90 PP.

	1	2	3	AV	SD
J	98.88	100.53	99.50	99.63	.84
L	97.66	98.63	96.95	97.75	.84
R	82.19	81.20	80.28	81.22	.96
S	91.94	90.44	88.74	90.38	1.60
V	81.17	79.72	78.68	79.86	1.25
W	92.72	90.43	89.18	90.78	1.80
P	110.02	109.15	111.52	110.23	1.20
Q	126.15	123.81	122.12	124.03	2.02
T	111.35	111.48	111.85	111.56	.26
U	129.98	127.44	128.95	128.79	1.28
K	99.24	97.89	99.23	98.79	.78
(R-S-V-W)	94.94	94.82	94.16	94.64	.42
(P-Q-T-U)	94.81	94.42	93.95	94.39	.43

VEL7 = 2259.783 + -4.0563 X. R=-.948 LOTS J,K,L,P,Q,R,S,T,U,V,W.
VEL5 = 1658.045 + -4.2419 X. R=-.970 LOTS J,K,L,P,Q,R,S,T,U,V,W.
PP 7 = 88.192 + -.4934 X. R=-.924 LOTS J,K,L,P,Q,R,S,T,U,V,W.
PP 5 = 28.894 + -.1501 X. R=-.932 LOTS J,K,L,P,Q,R,S,T,U,V,W.

Table 63 AQ, RQ (4-28, 1) (Picatinny)

PRESSURE RANGE 4 TO 28, DELTA KPSI= 1

ABSOLUTE QUICKNESS (PSI/MICROSEC)

	1	2	3	AV	SD
J	4.046	3.964	3.933	3.981	.059
L	4.062	3.948	4.041	4.017	.061
R	4.729	4.851	4.752	4.778	.065
S	4.081	4.009	3.993	4.028	.047
V	4.491	4.448	4.374	4.437	.059
W	3.663	3.642	3.584	3.630	.041
P	3.454	3.447	3.431	3.444	.012
Q	2.961	2.968	2.887	2.939	.045
T	3.200	3.129	3.087	3.139	.057
U	2.530	2.499	2.439	2.489	.046
K	4.001	4.033	4.023	4.019	.016
(R-S-V-W)	4.061	4.037	4.003	4.034	.029
(P-Q-T-U)	4.020	3.909	3.860	3.930	.082

VEL7 = 1506.031 + 92.3339 X. R= .905 LOTS J,K,L,P,Q,R,S,T,U,V,W.
VEL5 = 874.305 + 95.3506 X. R= .914 LOTS J,K,L,P,Q,R,S,T,U,V,W.
PP 7 = -1.359 + 10.6566 X. R= .837 LOTS J,K,L,P,Q,R,S,T,U,V,W.
PP 5 = 1.593 + 3.2570 X. R= .848 LOTS J,K,L,P,Q,R,S,T,U,V,W.

REFERENCE K COMPARED WITH SELF IN 3 LOTS OF 3 FIRINGS EACH

K	100.00	100.96	100.46
K	99.10	100.00	99.52
K	99.60	100.52	100.00
(R-S-V-W)	100.00	99.54	99.09
(R-S-V-W)	100.47	100.00	99.52
(R-S-V-W)	101.03	100.53	100.00
(P-Q-T-U)	100.00	97.90	96.79
(P-Q-T-U)	102.25	100.00	98.82
(P-Q-T-U)	103.56	101.23	100.00

RELATIVE QUICKNESS

	1	2	3	AV	SD
J	102.06	98.77	98.88	99.90	1.87
L	101.60	98.61	101.36	100.52	1.66
R	117.17	120.55	119.31	119.01	1.71
S	103.40	102.44	102.18	102.67	.64
V	112.97	113.06	111.50	112.51	.88
W	93.70	94.18	92.81	93.56	.70
P	86.39	88.25	88.60	87.75	1.19
Q	74.38	76.59	75.86	75.61	1.12
T	80.77	80.69	80.90	80.78	.11
U	64.56	65.32	64.25	64.71	.55

VEL7 = 1473.678 + 4.0104 X. R= .930 LOTS J, L,P,Q,R,S,T,U,V,W.
VEL5 = 843.285 + 4.1028 X. R= .932 LOTS J, L,P,Q,R,S,T,U,V,W.

III. INFLUENCE OF NUMERICAL METHODS ON CLOSED BOMB DATA

The further influence of numerical methods will be given in this section.

Figure 50: A plot of all 6 firings of lot S with RAD RC method. (Sample time 0.2 ms, and first 90 points plotted).

Figure 51: Same data plotted for a 9 point cubic fit.

Figure 52: Plot of Picatinny three firings of same propellent shows qualitative agreement with Radford plots (0.096 ms sampling).

Figure 53: This plot shows, not the influence of numerical methods, but the degree of variability possible in closed bomb plots. The case is reference lot fired for lot LL and mixture lot JKLL.

Figure 54: This graph compares the original raw pressure with the pressure after a 9 point cubic fit, and an RC fit. This signal is rather smooth to begin with, and the 9 point leaves it relatively unaltered. The RC fit has a small time lag as the RC pressure crosses exhibit a lag behind the 9 point fit in the steepest curve portion.

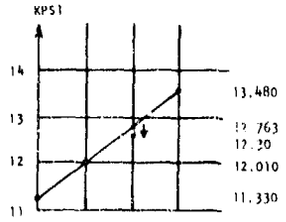
Figure 55: This emphatically shows the artificially enhanced derivative when the RC method is used.

Figure 56: The first firing of lot S is plotted with its associated reference firing, and RQ values are listed for the two numerical methods with different pressure intervals. A smaller RQ is expected as the interval increases as the ratios of the curves decrease (and even reverse) outside the 8-20 kpsi interval.

Figure 57: Second firing of lot S. The influence of successive smoothing and derivative calculation on original data is shown for a RAD RC fit. After 6 applications, a slight depression exists for the peak dp/dt value.

Figure 58: The same raw data of Figure 57 is used, but a 9 point cubic fit is used. Again the depression of the peak exists after six successive applications.

Figure 59: Second firing of lot S. Only one data point in the raw data was deliberately changed from 12.763 to 12.30 kpsi. Graphically:



The first 3 applications of a 9 point cubic fit is shown. Note the influence extending to four points on either side of the altered point for the first application.

Figure 60: The localized influence of a RAD RC fit is shown for the same initial data as for Figure 59.

Figure 61: Application of a 9 point cubic fit on the unaltered data, and 6 applications on the altered data are shown. The characteristic is a depression near the peak with greater convexity just off the peak toward lower pressure. The straightening out at about 8 kpsi is not due to this alteration.

Figure 62, 63, 64: These are examples of further filtering by use of a 9 point QUADRATIC rather than a cubic fit for the test and reference firings at Radford. The QUADRATIC fits are similar to the cubic up to about 18 kpsi, but depress the peak dp/dt by about 8%.

Figure 65: These distorted plots of the reference firings occurred when a 19 point QUADRATIC fit was used on the Radford data. After 16 kpsi, the dp/dt vs p curve becomes severely depressed, with peak dp/dt about 20% lower than a 9 point CUBIC fit.

Figure 66: In the 19 point CUBIC fit for the reference firings (compared to 9 point CUBIC fit), after about 14 kpsi, the dp/dt value starts increasing to about 2%. However, at the peak, the dp/dt value is depressed about 2%.

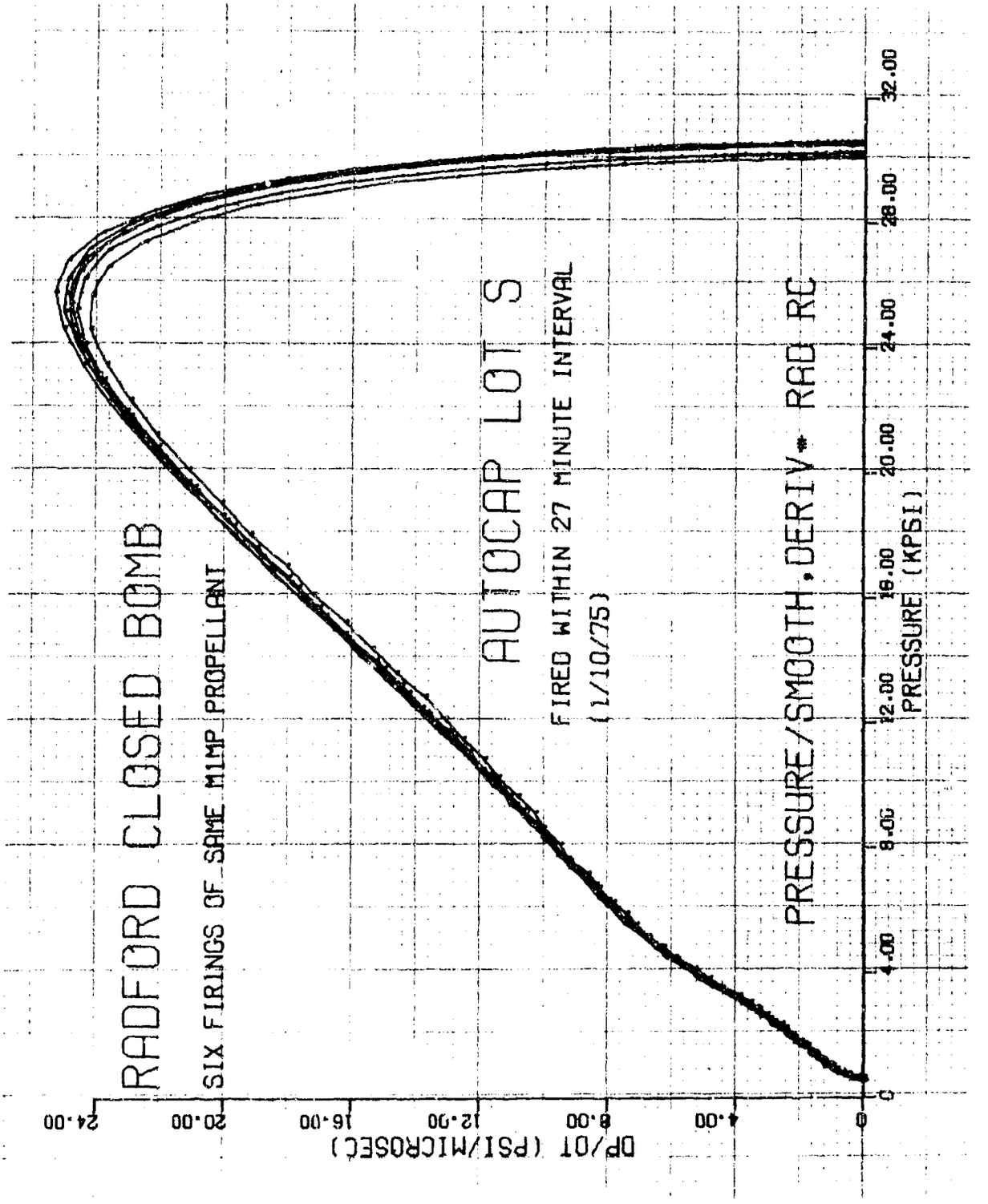


Figure 50 Radford Lot S Firings (Rad RC)

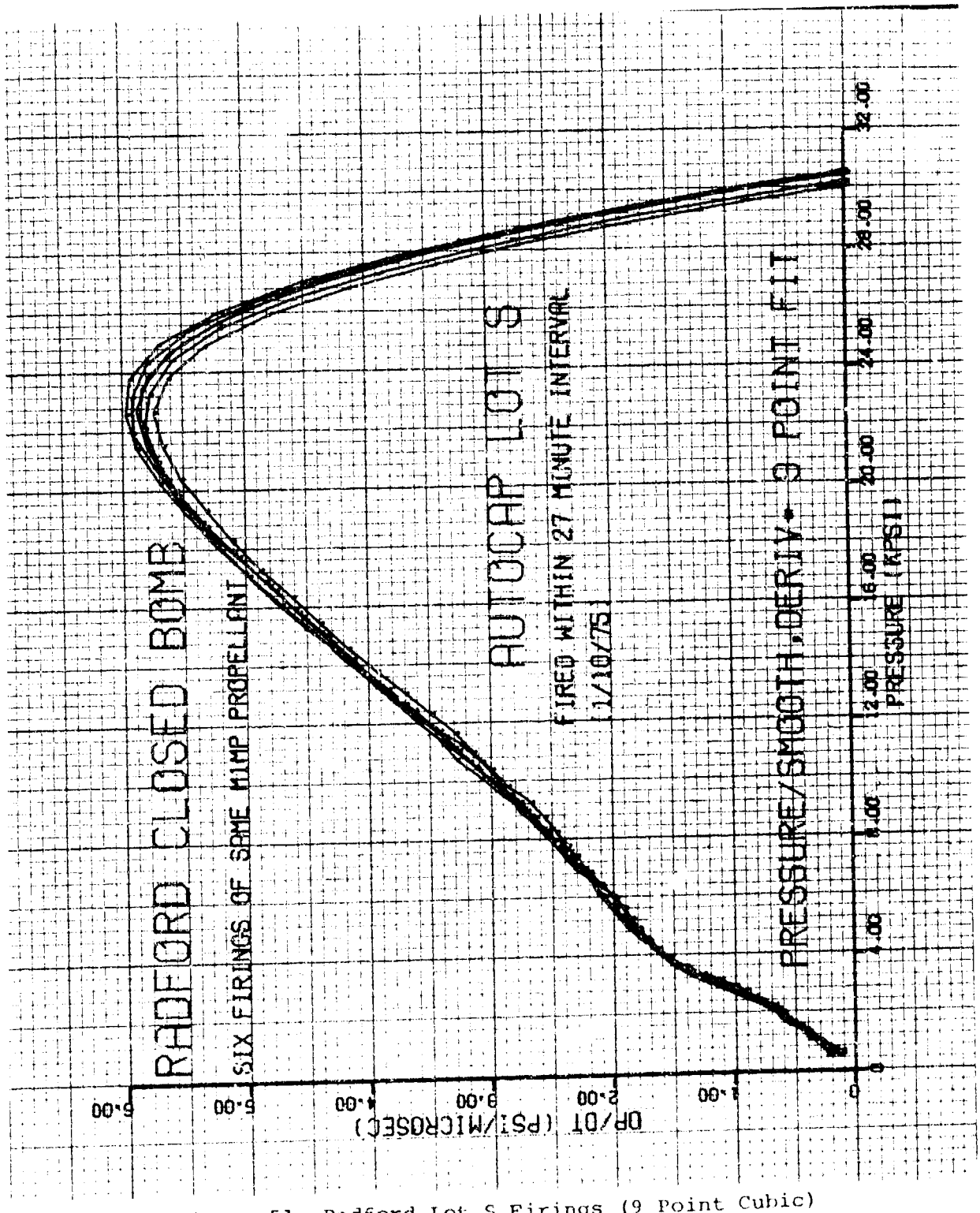


Figure 51 Radford Lot S Firings (9 Point Cubic)

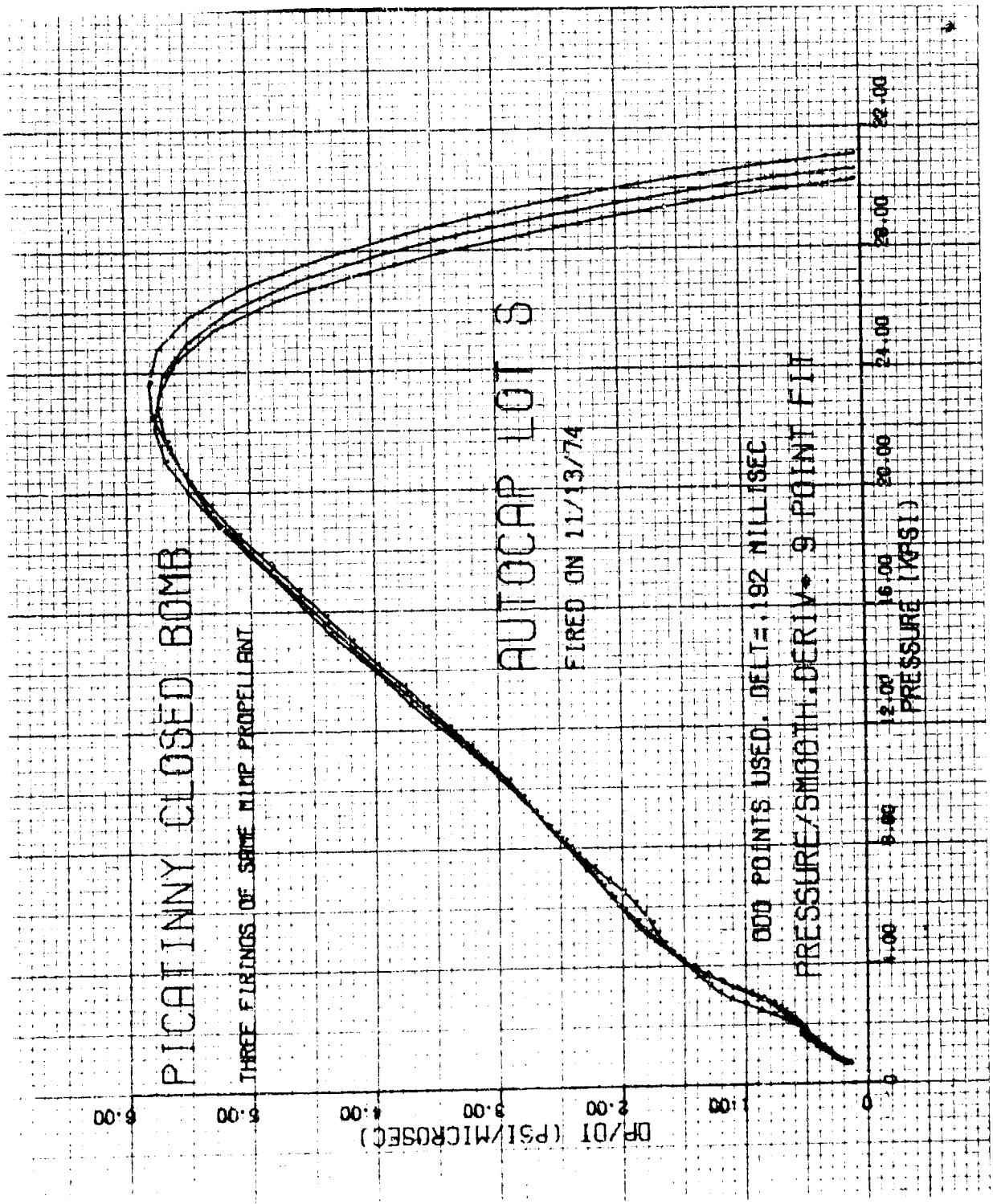


Figure 52 Picatinny Lot S Firings (9 Odd Point Fit)

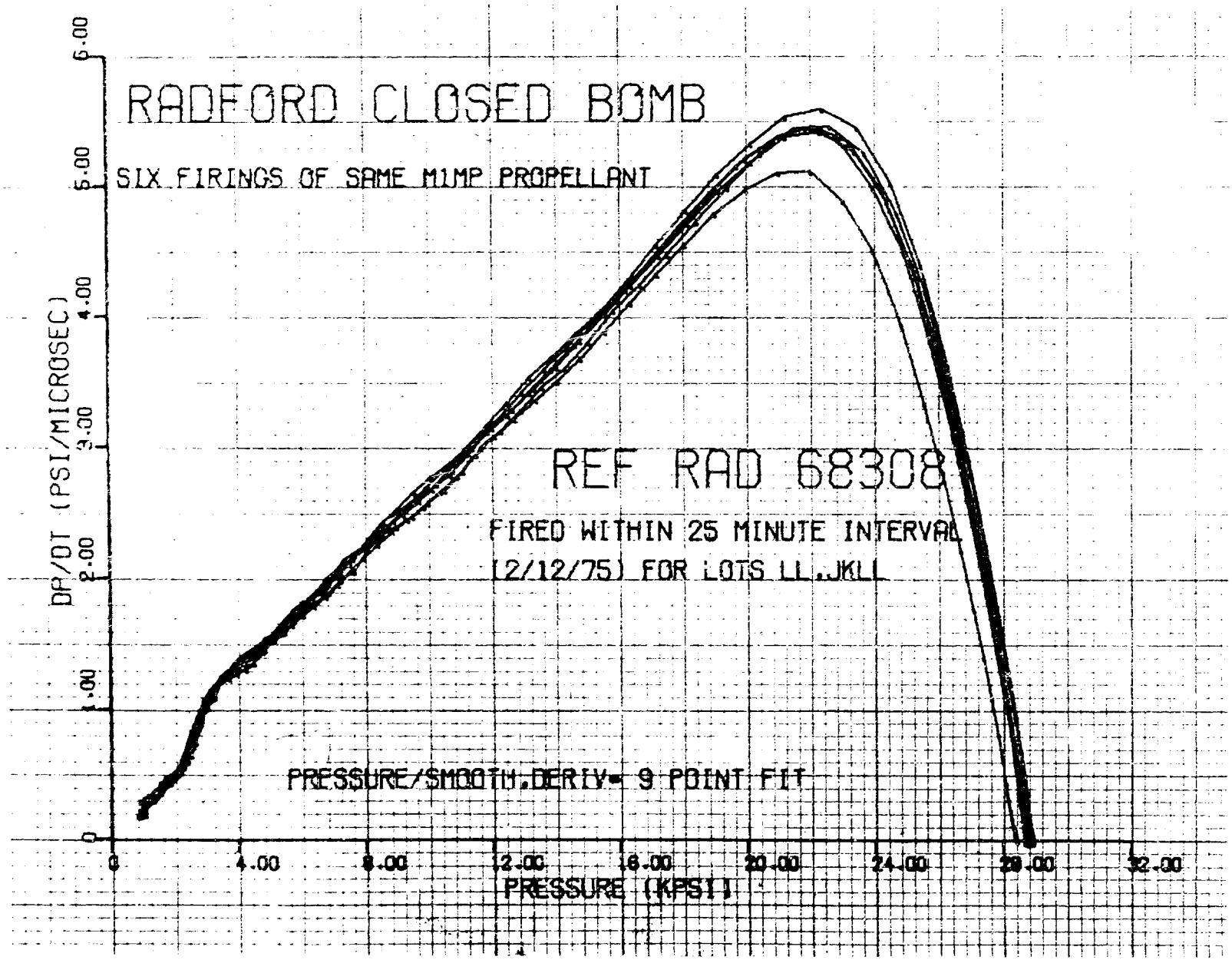


Figure 53 Radford Reference Firings for Lot LL (9 Fit)

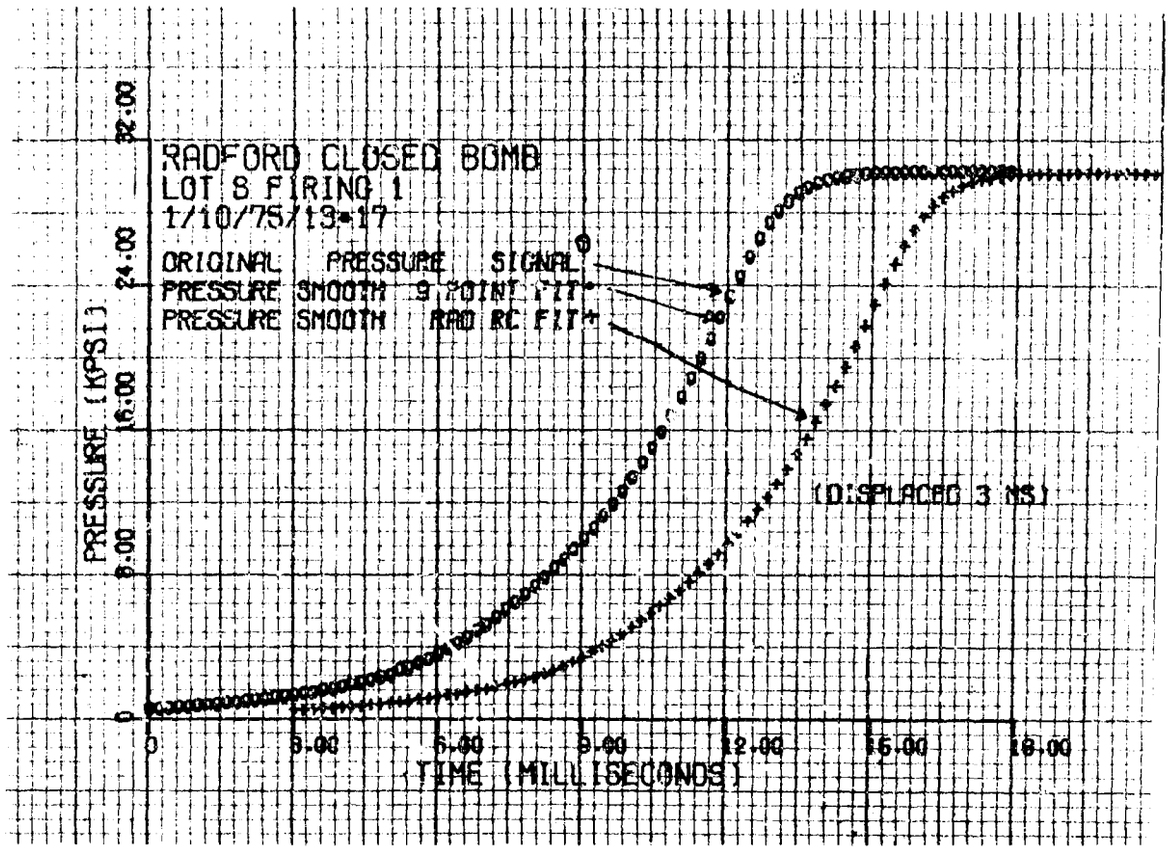


Figure 54 Pressure-time of Lot S First Firing

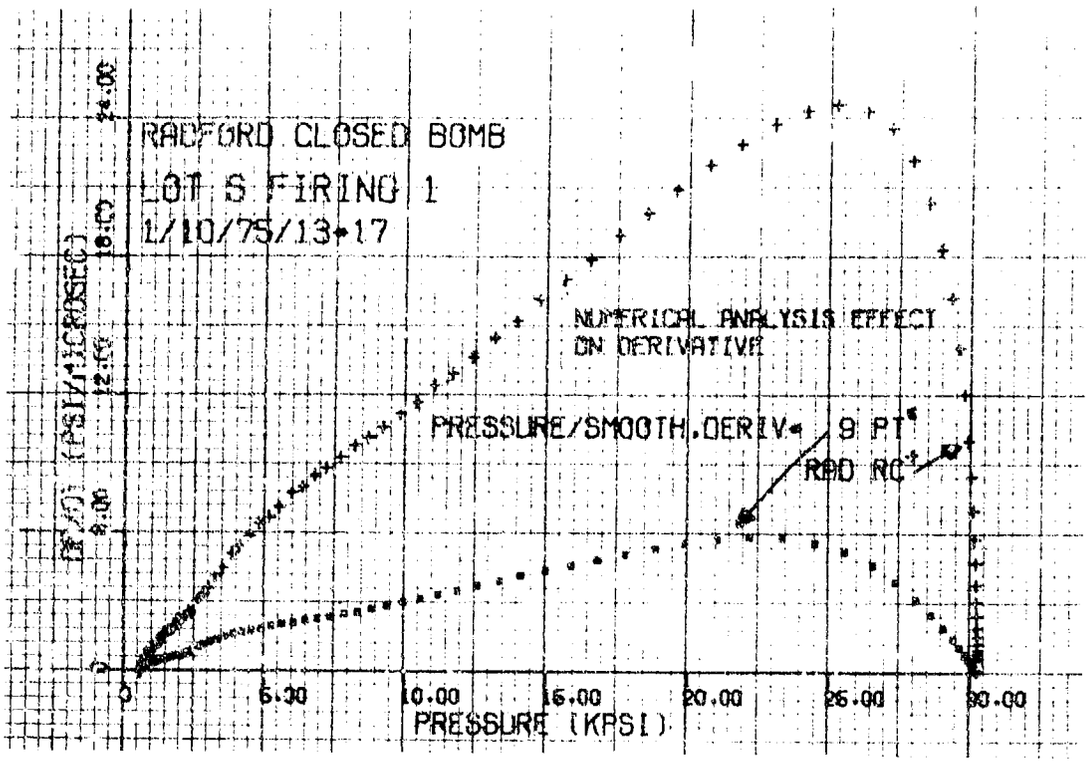


Figure 55 Derivative Effect on Lot S First Firing

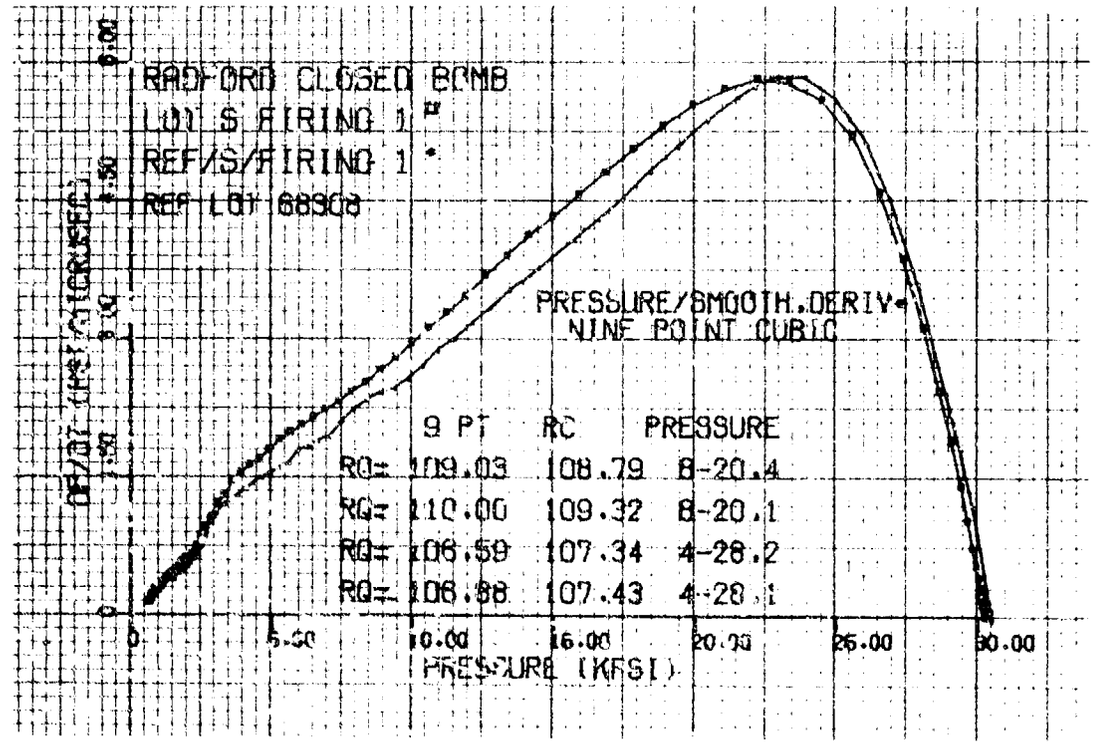


Figure 56 RQ Variation for Lot S First Firing

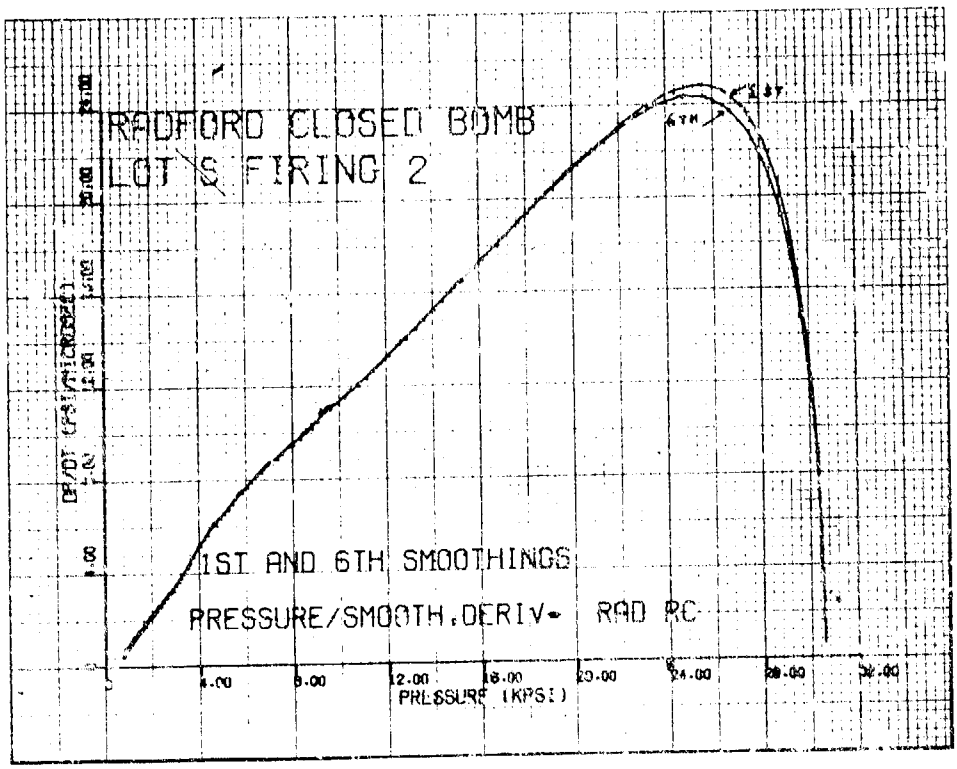


Figure 57 Successive Rad RC Fit on Lot S Second Firing

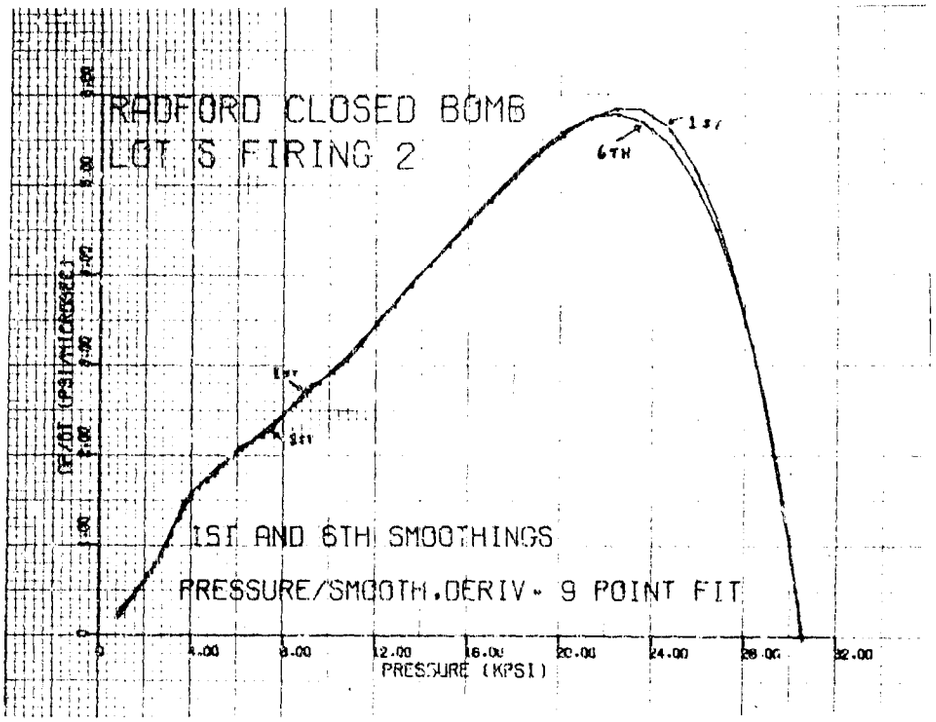


Figure 58 Successive 9 Cubic Fit on Lot S (2)

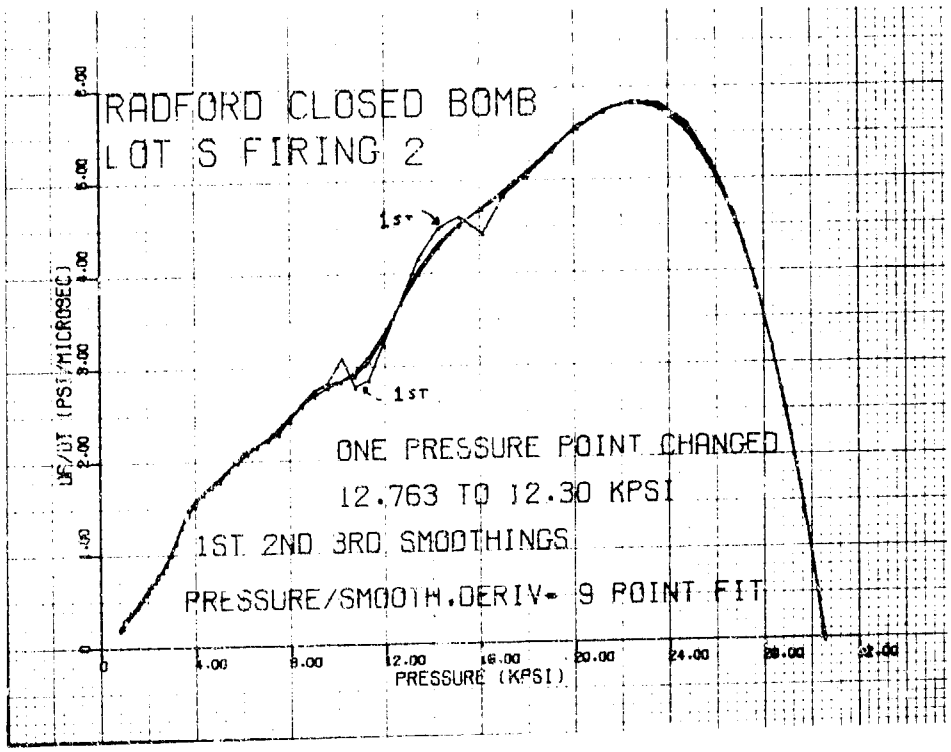


Figure 59 Pressure Change, 9 Cubic Fit on Lot S (2)

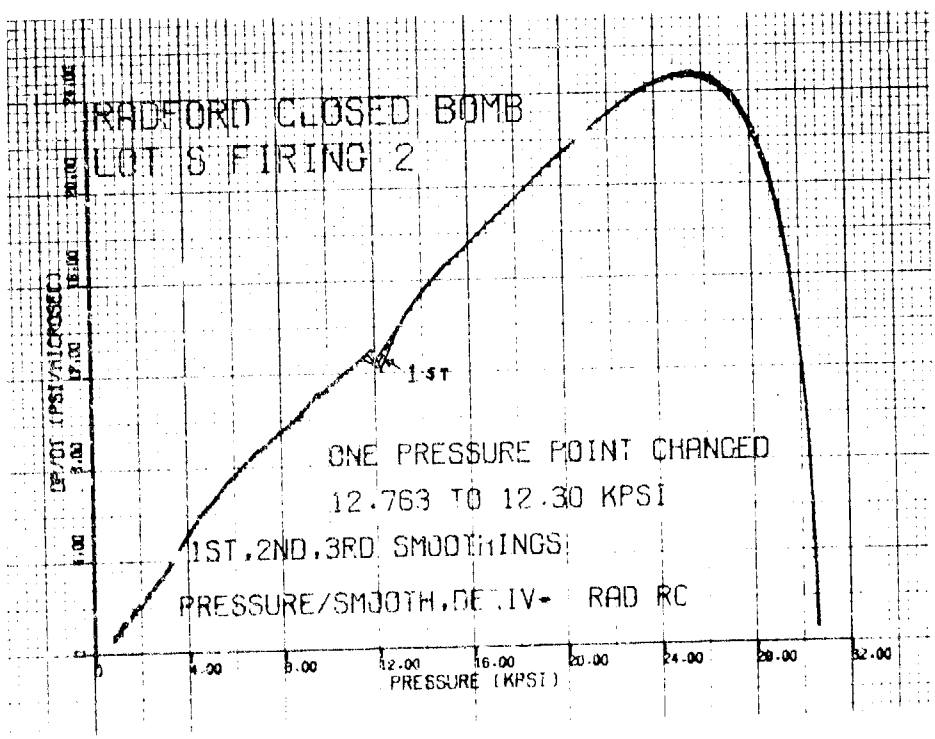


Figure 60 Pressure Change, Rad RC Fit on Lot S (2)

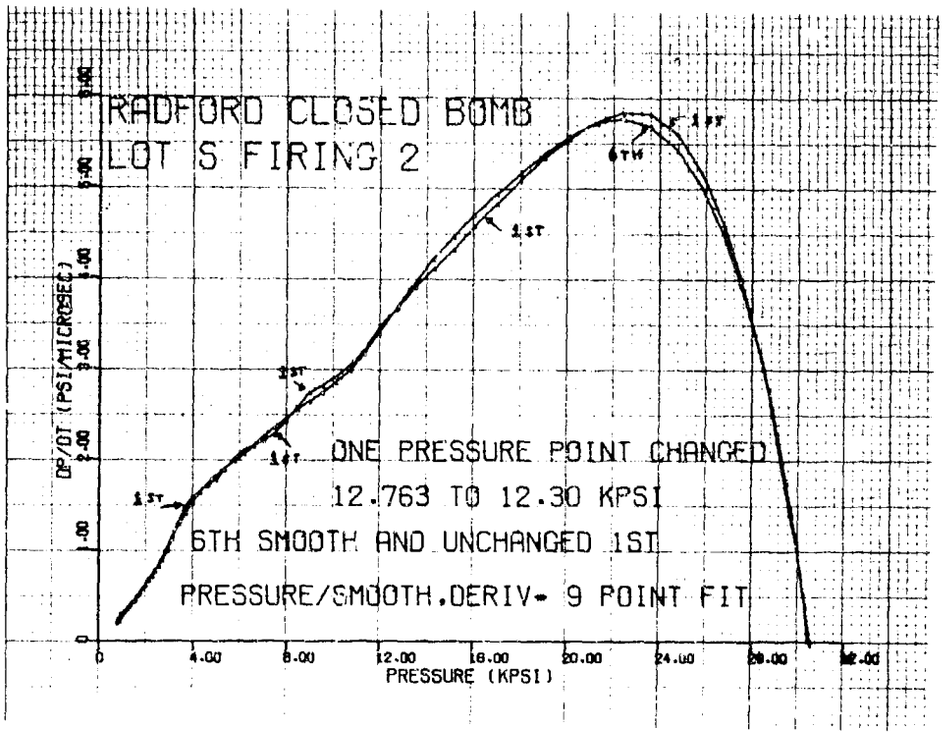


Figure 61 Unaltered, Altered Pressure on Lot S (2)

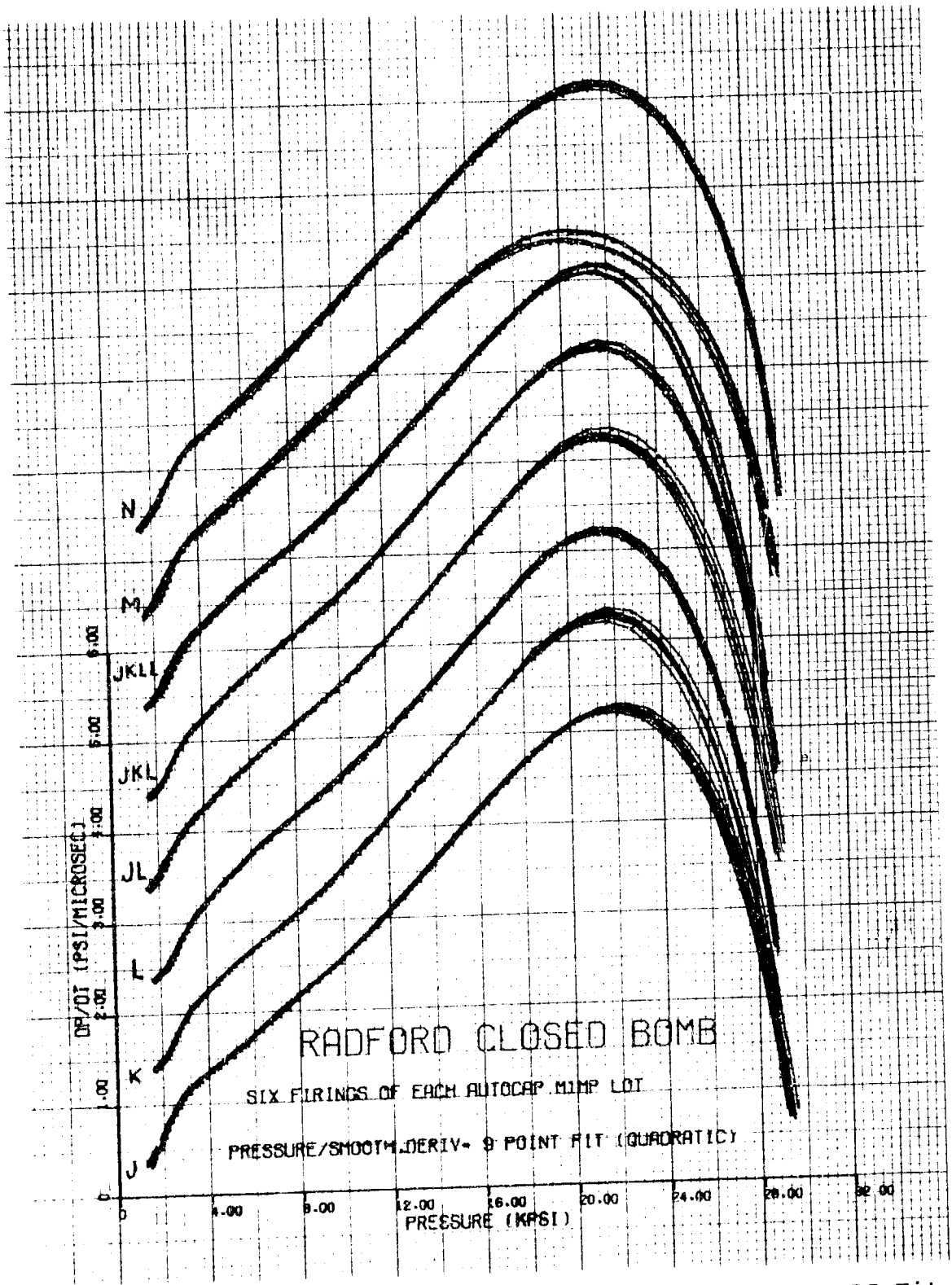


Figure 62 Radford, J-N Plots, 9 Point QUADRATIC Fit

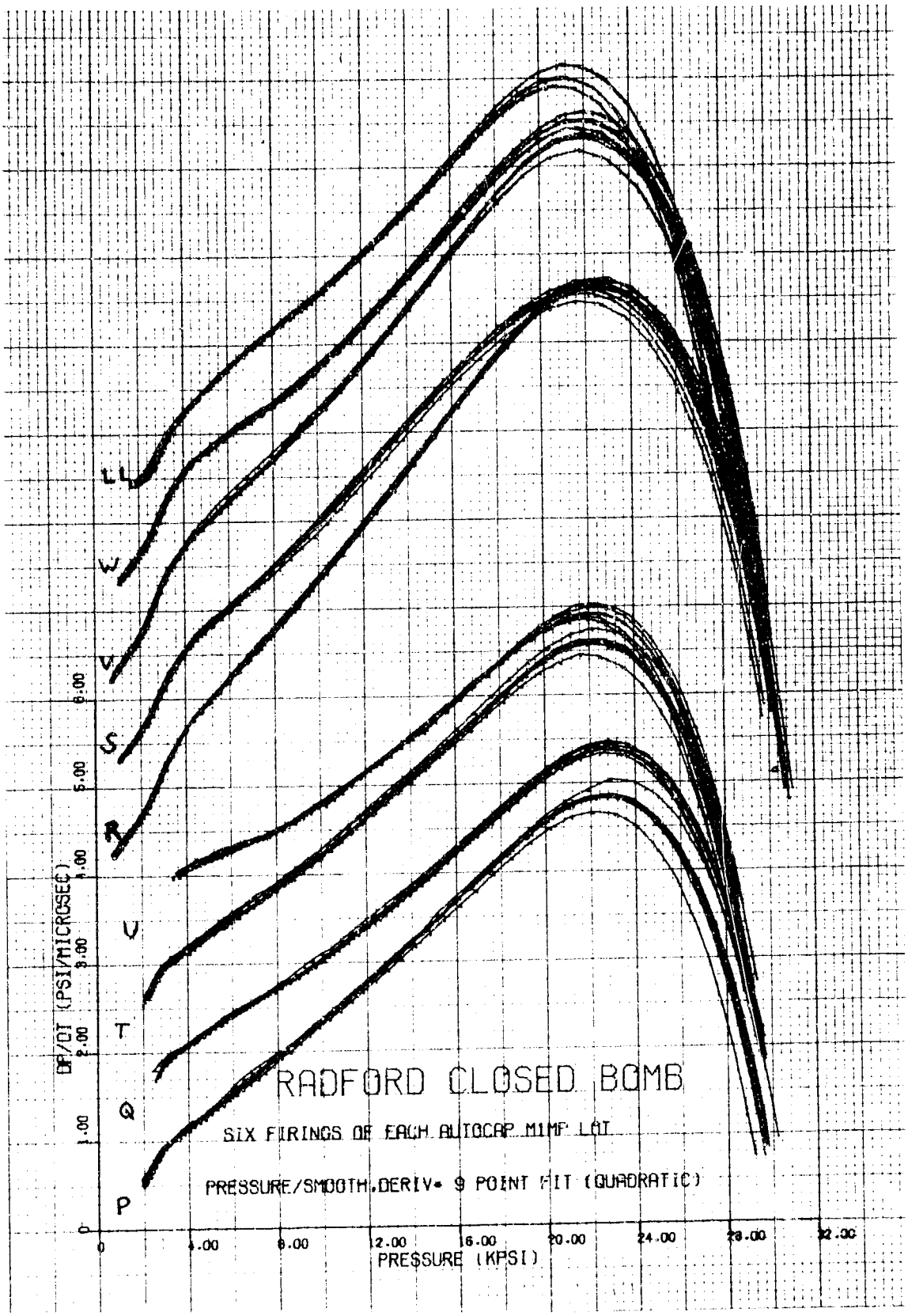


Figure 63 Radford, P-LL Plots, 9 Point QUADRATIC Fit

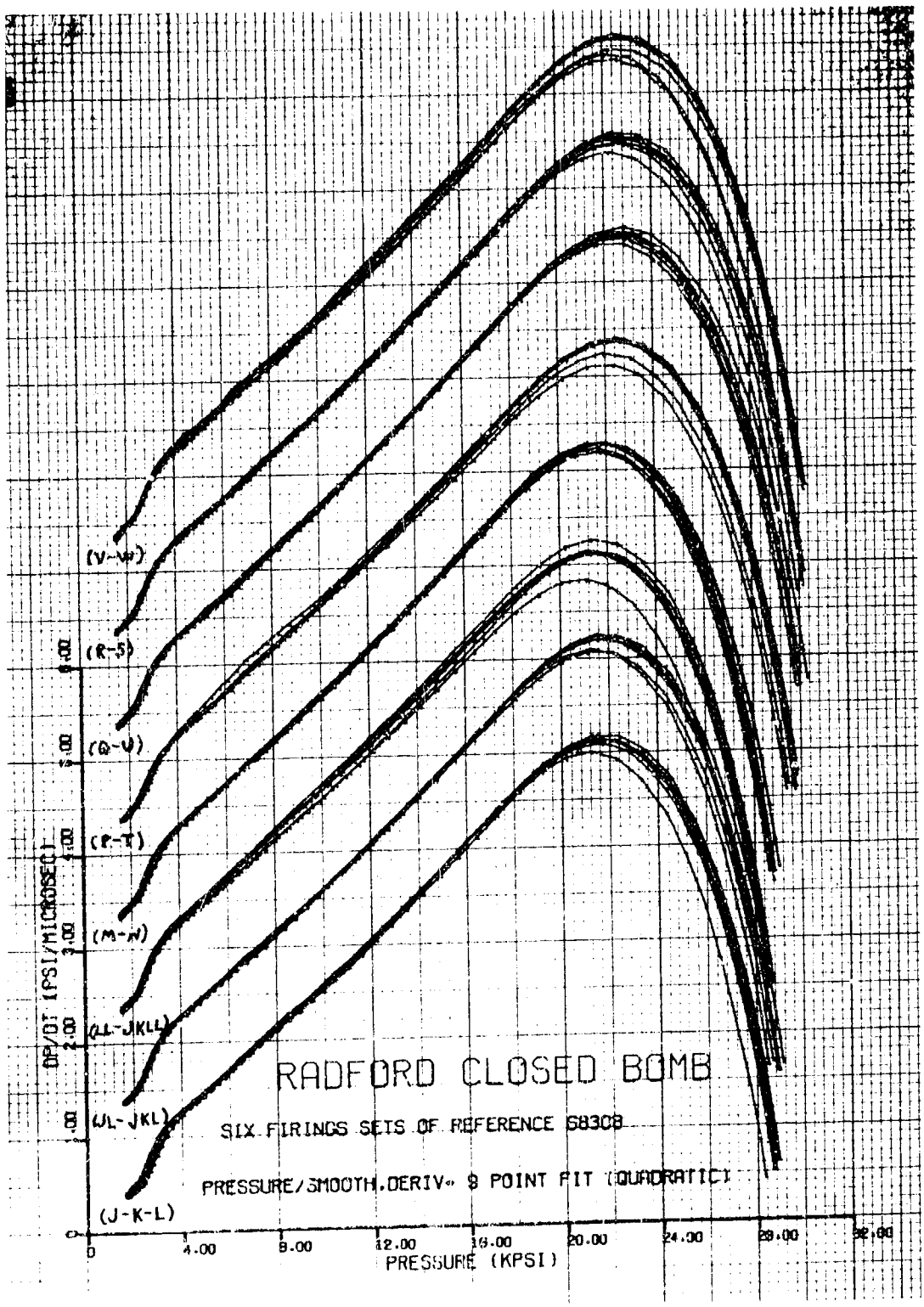


Figure 64 Radford, Reference Plots, 9 Point QUADRATIC Fit

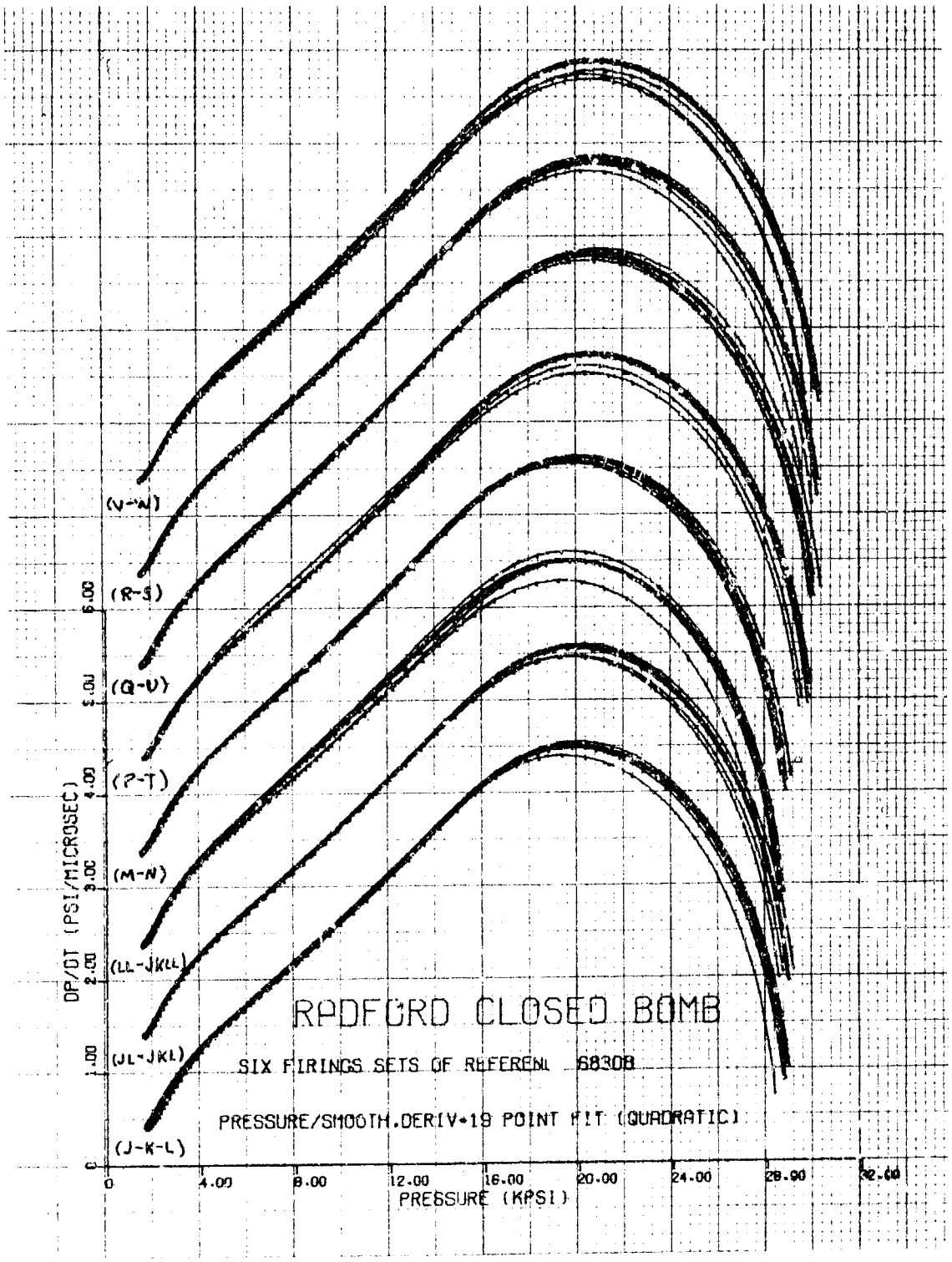


Figure 65 Radford, Reference Plots, 19 Point QUADRATIC Fit

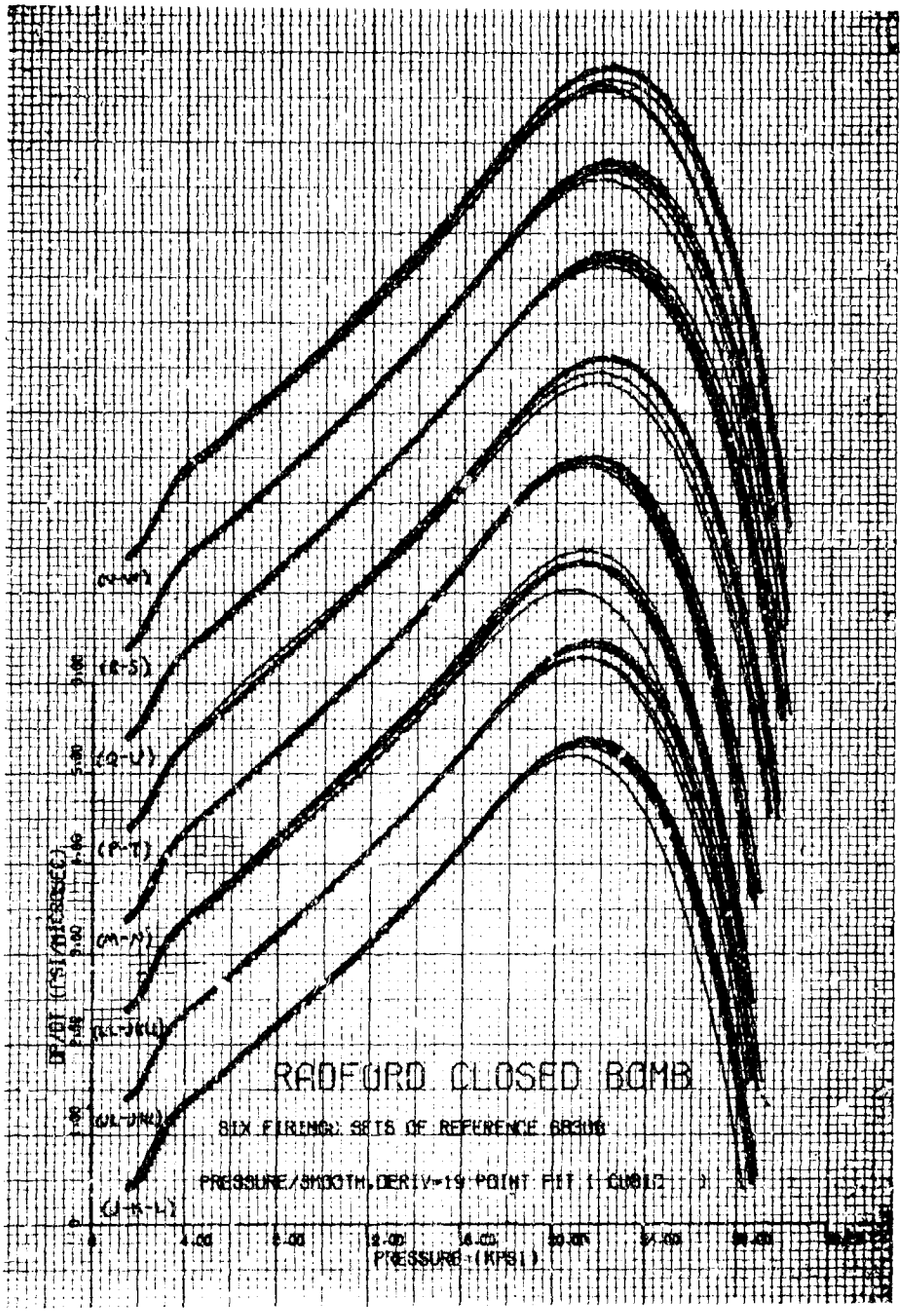


Figure 66 Radford, Reference Plots, 19 Point CUBIC Fit

Conclusions and Recommendations:

These conclusions and recommendations are based on the AUTOCAP single base M1 propellant lots and reference lot 68308 for the M4A2 charge, 155mm howitzer, fired ballistically and in the Radford closed bomb.

Conclusions:

1. The use of reference propellant firings can introduce a maximum variation in RQ, as presently calculated, of about 2%.

2. The present Radford RC algorithm, though effectly treating the pressure trace for RQ calculation, produces an enhanced derivative and numerically distorts the closed bomb plot of dp/dt vs p.

3. Closed bomb information by itself gave unacceptable criteria for good correlation with either zone 7 or zone 5 howitzer firings.

4. The simultaneous (a) use of least square cubic fit for both smoothing and differentiating the pressure data, (b) use of the customary dp/dt vs p plot over a wider range of pressure than specified in MIL-STD-286B, and (c) elimination of reference closed bomb firings gave as good as, and even better correlation with ballistics.

5. Over the past several years, diversities of data acquisition hardware and numerical analysis methods have developed throughout the ordnance community. No one method has in the past proved itself superior to the others and none has proved an accurate indicator of propellant performance in the gun. Standardization of the operating system based on physically reasonable parameters is dictated.

Recommendations:

Several of these recommendations arise from anticipation of absolute measurements for the closed bomb and incorporation of a program for correlation with ballistics.

1. Apply a least squares type numerical analysis on the pressure data for smoothing and differentiating.

2. Employ the use of a conventional charge amplifier directly onto the pressure transducer. If this conventional hardware gives less signal distortion, initiate an analytical-experimental study to find the relation of past closed bomb RQ and RF values to the new electronics system by reason of the historical significance of past data. The overall objective is to obtain as true a representation as possible of the pressure on the closed bomb wall.

3. Analog filters in the electronic circuitry should not degrade the pressure signal.

4. For data reduction, the converter should digitize the pressure into a sufficient number of points, so the pressure interval between any two successive samples is no greater than 500 psi.

5. Eliminate the use of reference propellant firings in calculations, as inherent variability in closed bomb traces of the same propellant introduces variability in the final numerical answers.

6. The data reduction system should include flexible programming software, (e.g. Fortran), with sufficiently complex programming to diagnose each shot so that error messages will be generated for data which appears suspicious and pressure data would be subject to a broader analysis.

7. Besides calculation of RQ and RF, the data should be analyzed on an absolute basis in terms of AQ and AF, or several variations of the absolute approach where reference propellant is not considered. This is needed to supply a list of variables for statistical correlation with ballistics.

8. The closed bomb pressure data for propellant selected from drums used in eventual ballistic assessment and uniformity firings for a lot should be subjected to these special analyses and methods, and correlated with gun firings from the respective drums. This is also a check on the homogenity of the lot mixing.

9. Closed bomb instrumentation should be calibrated with sufficient accuracy by a charge amplifier to obtain the absolute pressure trace, and history kept of its calibration characteristics, as further insight into closed bomb variation. Influence of temperature on the gage may be pertinent if the gage experiences cyclic heating in the bomb.

10. A computer program be written that will consider statistically propellant properties (chemistry, geometry) with closed bomb and ballistic simulator data to find on an on-going basis which parameters have the most relevance ballistically.

11. Continue improvements on and firings with gun simulators and propellant test devices as a supplement to closed bomb data. (Subject is covered in a subsequent report).

12. Experimentally compare the present 4-crystal piece piezo gage and the associated asbestos packing with other commercial gages for linearity, reliability, maintainability, and intrinsic physical properties as capacitance, impedance and resonances.

13. It is uncertain whether the ignition system be redesigned to one of more rapid and more consistent initial pressurization. The high pressure gage used cannot monitor this low pressure region for acquiring a history of data.

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6. Firing Record No. P-82467, 31 January 1975, APG TECOM Project No. 2-MU-004-018, Product Improvement Test, Evaluation of Propellant Variables on Ballistic Performance of 155-MM Propellant Charge M4A2 (Related firing record P-82448, 23 October 1974). (AUTOCAP Lots P-W.)

7. Firing Record No. P-82484, 9 June 1975, APG TECOM Project No. 2-MU-005-001-033, Product Improvement Test, Evaluation of Propellant Variables on Ballistic Performance of 155-MM Propelling Charge, M4A2. (AUTOCAP lot blend JKLL.)

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APPENDIX A BATCH BLENDING AND BALLISTIC TESTS

To achieve the greatest possible grain homogeneity, the batch production process (at RAAP) is utilized to the greatest degree at various stages in the grain cycle. The following description illustrates this approach. The actual numbers used are close to the production values, but there are variations depending on grain perforation, size, composition, and actual lot final weight.

SINGLE BASE PROPELLANT:

Consider single base, multiperf propellant for the M4A2 charge, 155mm howitzer. (M1, M6, NACO). The final lot for acceptance may consist of 450,000 lb, which had been formed from about 90 batches of 5000 lb each. The procedure follows the general scheme illustrated in Figure 67.

1. Mixes are made of about 400 lb each.

2. The extruded mixes are sent to the cutting house where up to eight cutting machines can be in operation. The first "blending" operation occurs here as at any time there may be several different mixes being cut. The cut grains are about 30% solvent rich, and buggies with 750 lb loads are sent to solvent recovery.

3. Solvent recovery: The buggies are dumped consecutively into five, 4500 lb grain holders. The grains become about 7.5% solvent rich, and contents of each holder is divided between two 50,000 lb holders for the wet, dry cycle.

4. Wet, dry: Further solvent is released in a 130°F water soak to bring solvent below 1%. Each of the 50,000 lb holders are poured into ten air dry towers of about 5000 lb each (BATCH designation is reached).

5. Air dry: Air at about 145°F is forced through the dry towers (about 18' high). At the end of this cycle for each tower, the contents are loaded into about 90 numbered bags (about 55 lb each).

6. Batch bagging: The bags loaded from the bottom of the tower have a higher water content, and if the water content versus bag number were plotted for any particular batch, the line would have a negative slope, as indicated. If the overall water content of a tower is lower (say 0.2%), then the line is of less negative slope.

7. Array blend: In this example, the 90 bags from the first batch are placed in a vertical row. The bags from the 2nd batch are placed in a parallel row, BUT with the last loaded bag placed adjacent with the first loaded of batch one. This sequencing is continued for all the batches.

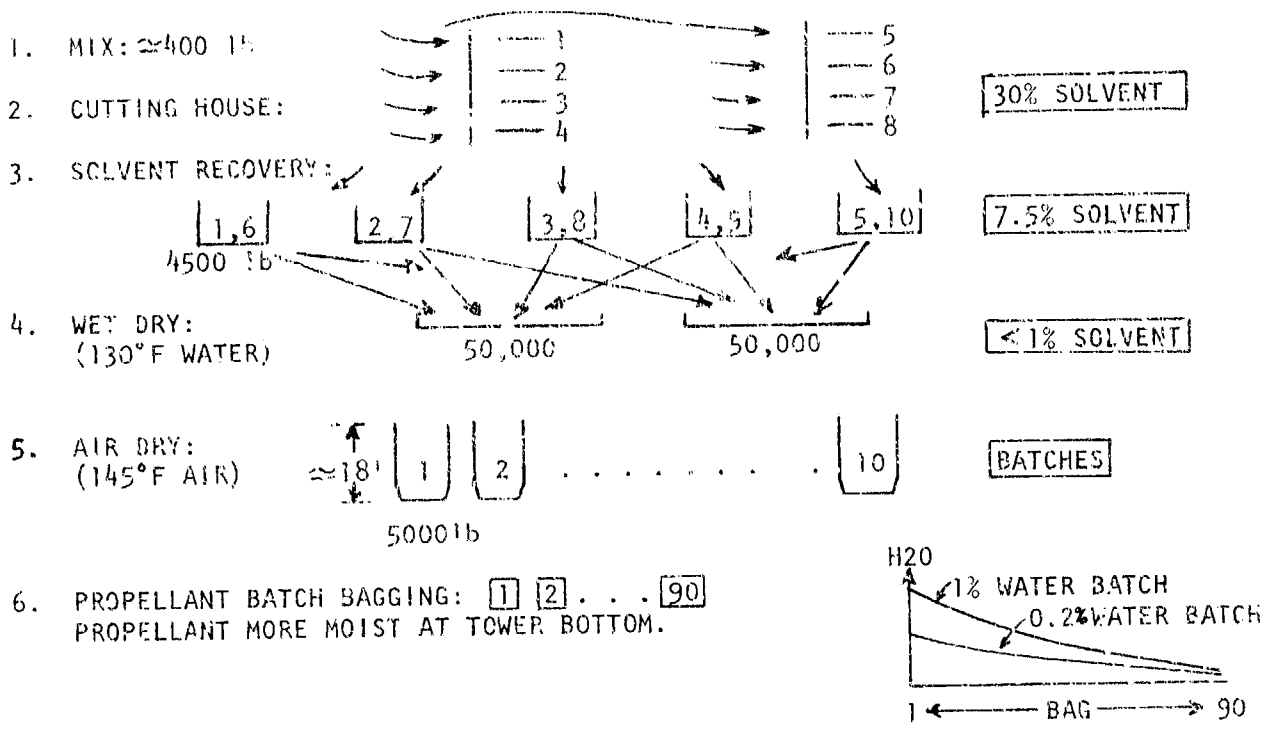


Figure 67 Single Base Batch Blending

6. Cross blending: Each horizontal row of 90 bags each is physically blended in a 5000 lb mixer, and the final contents poured into about 33 drums. Depending on the type of propellant, final drum weight is:

M1SP ..... 110 lb
MP(105) ... 140 lb
MP(155) ... 145 lb
M6 ..... 160 lb

The final lot thus yields about 3000 drums (or boxes), of about 145 lb each, for the 450,000 lot.

Sampling and Closed Bomb Testing:

This example of M1MP, M4A2 charge propellant is continued with data from Rad Lot 69550 for the 155mm. Each of the about 90 batches in the final lot make-up is analyzed for water content and tested for RQ in the closed bomb. For example, gas chromotography for moisture yielded for the 92 batches an average of 0.465%. The lot average RQ was 98.2%.

In lot 69550, an average moisture reading is reported for about each 5 batches, and an average RQ for about each 10 batches. If the mean and standard deviation are calculated from these reported averages:

	N	AV	SD
Moisture	20	0.43	0.16
RQ	10	98.5	2.53

At this stage if it is found that the water content is below normal, a specific amount of water is designated to be added to each 5000 lb cross blend mixing, just prior to loading in drums (4 pts for lot 69550).

Seven out of the 3000 can lot are selected for shipment to the proving ground for assessment and uniformity prop charges. However, during the filling of these cans, about one pound of propellant is reserved. (A very small portion of each of these seven pounds is blended together and 30 grains are then selected and analyzed chemically and inspected for geometry, and reported as such for the lot).

Each of the seven samples is analyzed for water content and six closed bomb firings are made of each sample. A reference propellant firing is made before each set of three test propellant firings. The six RQs (and RFs) are averaged and reported as the RQ (RF) for that can. The seven averaged RQs (and RFs) are then averaged and reported as the RQ (RF) for that lot. For this example, a 4% RQ range is employed. Any firing outside this range is rejected and the firing repeated.

For the lot 69550 example, the reported final lot test results were:

Can No.	H_2O	RQ	RF
165C	0.49	96.50	99.71
39C	0.69	97.33	99.92
157C	0.54	96.10	100.01
405C	0.51	96.33	99.78
306B	0.54	97.84	99.86
938C	0.53	96.90	99.87
886B	0.71	97.89	100.21
Average	0.56	96.98	99.91
Range	0.22	1.79	0.50

Multiple Base Propellant:

1. Mixes are about 450 lb.
2. Cutting is same as for single base.
3. Cuttings are kept on about 22 trays (about 20 lb each) in cabinets.
4. Forced air drying only is used (145°F from 40 to 200 hours). The identity of mixes are kept to this point.
5. For GLAZE operation, about 5500 lb plus 0.2% graphite are placed in 3 hour cycle. Final glazed grains constitute a BATCH, and are loaded into drums of about 150 lb each. (There are 2 bays each 8000 lb).
6. Fifty stacks of such 32 drum batches constitute a LOT of about 250,000 lb.

(For casting powder, the above procedure is called a sublot at about 150,000 lb. Seven sublots are blended to constitute a 1,050,000 lb master lot).

E.2 Propellant Assessment, Uniformity, Acceptance Tests

Two specific examples will be used for the M4A2 charge for the 155mm, M1A1 howitzer for Lots Rad-69275 and 69395. Data on pressure will not be considered, only 70°F temperature firings. (The 145°F firings in uniformity (7 at zone 7) and in acceptance (5 each at zones 3 and 7) are omitted, and calculation indicated their omission does not change the figures plotted).

There are three stages for consideration:

1. CHARGE ASSESSMENT: The 7 marked drums (after samples taken for closed bomb tests at Radford) of propellant are sent to Jefferson. Three charges are loaded at each of 4 zones with the weights specified in Artillery Ammunition Master Calibration Chart, TECOM, APG, Report No. 1375 (17th revision, May 1976).

Zone	C.W. (ozs)	Desired Velocity (fps)
7	212.4	1850
6	157.4	1520
5	112.8	1230
3	65.6	900

In addition, three charges at each of these zones are loaded from the reference propellant for this lot (68308), and also a 7X (5% greater charge).

The mean of the three reference (calibration) firings at each of the four zones is subtracted from the desired velocity at that zone. This difference is added to (or subtracted from, if negative) the mean of the three test firings to obtain an ADJUSTED test velocity. Illustrated for Lot 69275:

C.W.	Zone	Velocity	Mean	Adjusted
212.4	7	1850	-(R)1839.0 = 11	
			(T)1840.3 + 11	= 1851.3
157.4	6	1520	-(R)1504.7 = 15.3	
			(T)1505.0 + 15.3	= 1520.3
112.8	5	1230	-(R)1213.7 = 16.3	
			(T)1209.0 + 16.3	= 1225.3
65.6	3	900	-(R)887.3 = 12.7	
			(T)883.7 + 12.7	= 896.4

(R) reference
(T) test

2. CHARGE UNIFORMITY: A better estimate is made at zone 7. Assessment at zone 7 showed that the test mean, corrected to the reference mean, gave 1.3 fps too high velocity. The velocity/charge weight ratio in this region is about 7 fps/oz. This indicates that zone 7 should be loaded with about 0.2 oz. less charge. (Actually, uniformity loading showed 1.2 oz. less charge. This loading is usually determined not by the charge slope method, but by a constant slope method after a large number of lots have been fired to provide a good knowledge of the propellant characteristics.)

Two charges are prepared from each of the 7 drums: one charge at each 70 and 145°F firing. For the lot these results were:

Temperature	Zone	C.W. (oz)	
70	7	212.4	7 REF mean velocity was 1834.1
			1850-1834.1 = 15.9 too low.
		211.2	7 TEST mean velocity was
			1824.9 + 15.9 = 1840.9
145	7	212.4	7 REF mean velocity was 1865.7
		211.2	7 TEST mean velocity was
			1853.4 - 7 = 1846.4

Data from assessment and uniformity firings indicate velocity from drum 464-A gave a lower velocity. Investigation whether trends (velocity from certain drums) are statistically correlated to inhomogenous mixing of a lot apparently has not been done.

Charge-velocity and charge-pressure curves are fitted by the method of least squares to give a linear relationship for guns and a second degree polynomial for howitzers (Reference 8).

If the 19 corrected velocities (12 Assessment and 7 Uniformity at 70°F) are fitted to a quadratic, the resulting equation is:

$$V = 399.4 + 7.9082CW - 0.005100*CW*CW$$

The Proving Ground recommended CW is listed on Figure 68 to give the desired velocity (VEL). The value calculated from the parabolic fit comes very close to this desired velocity for each zone (and to the final ACCEPTANCE mean at zones 3 and 7).

3. PROPELLANT ACCEPTANCE: After loading of this lot at Indiana AAP, five firings were made at zone 3 and at zone 7 (for both 70 and 145°F). Similar firings are made of reference propellant. Results show that when the test firings were corrected to the reference, mean for zone 7 was 1848 with a standard deviation of 2.9 fps.

The basic ballistic data used to plot Figure 68 is listed in Table 64.

Table 64 Lot Rad-69275 Partial Ballistic Data

CHARGE WEIGHT-CORRECTED VELOCITY(70 F) RAD-69275 (155MM,M1A1,M4A2)

Z	CW	ASSESS V	Z	CW	UNIFORM V	Z	CW	ACCEPT V
7	212.4	1850.0	7	211.2	1843.0	7	212.0	1849.0
7	212.4	1851.0	7	211.2	1840.0	7	212.0	1846.0
7	212.4	1853.0	7	211.2	1844.0	7	212.0	1851.0
6	157.4	1518.0	7	211.2	1845.0	7	212.0	1850.0
6	157.4	1522.0	7	211.2	1837.0	7	212.0	1844.0
6	157.4	1522.0	7	211.2	1837.0	3	66.0	929.0
5	112.8	1224.0	7	211.2	1840.0	3	66.0	892.0
5	112.8	1226.0				3	66.0	894.0
5	112.8	1225.0				3	66.0	898.0
3	65.6	891.0				3	66.0	881.0
3	65.6	899.0						
3	65.6	900.0						

Several pertinent Proving Ground data sheets for lot 69275 are listed as Table 65.

Lot Rad-69395 was analyzed by the same approach. This lot was less energetic. A -17 fps correction was applied to zone 7 test assessment firing. The final plot is given in Figure 69.

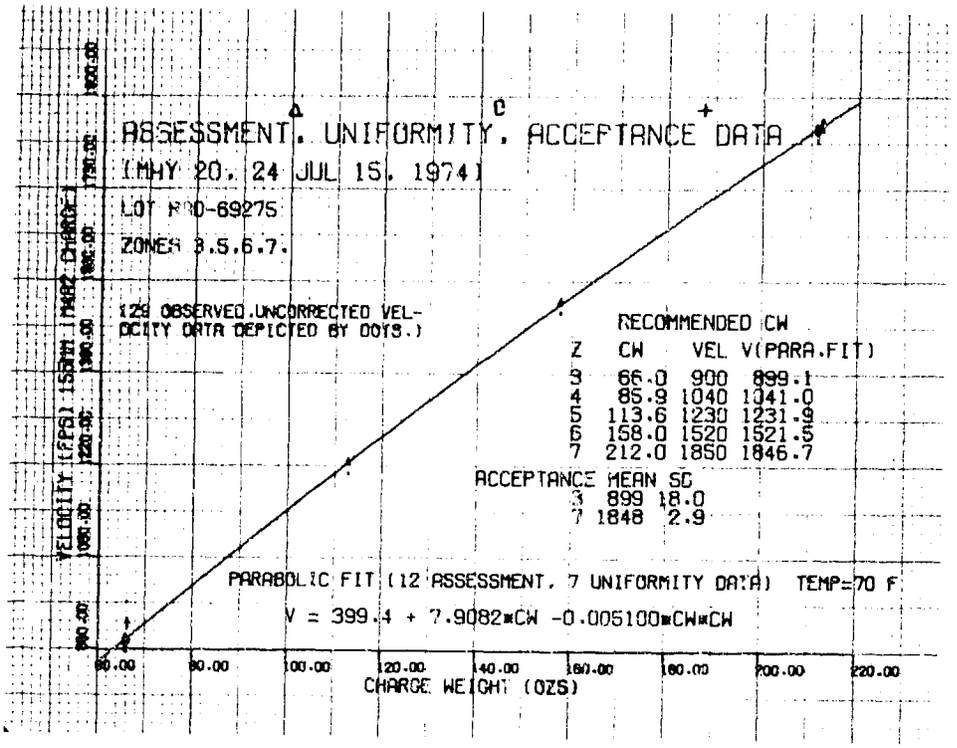


Figure 68 Lot Rad-69275 Ballistic Plot

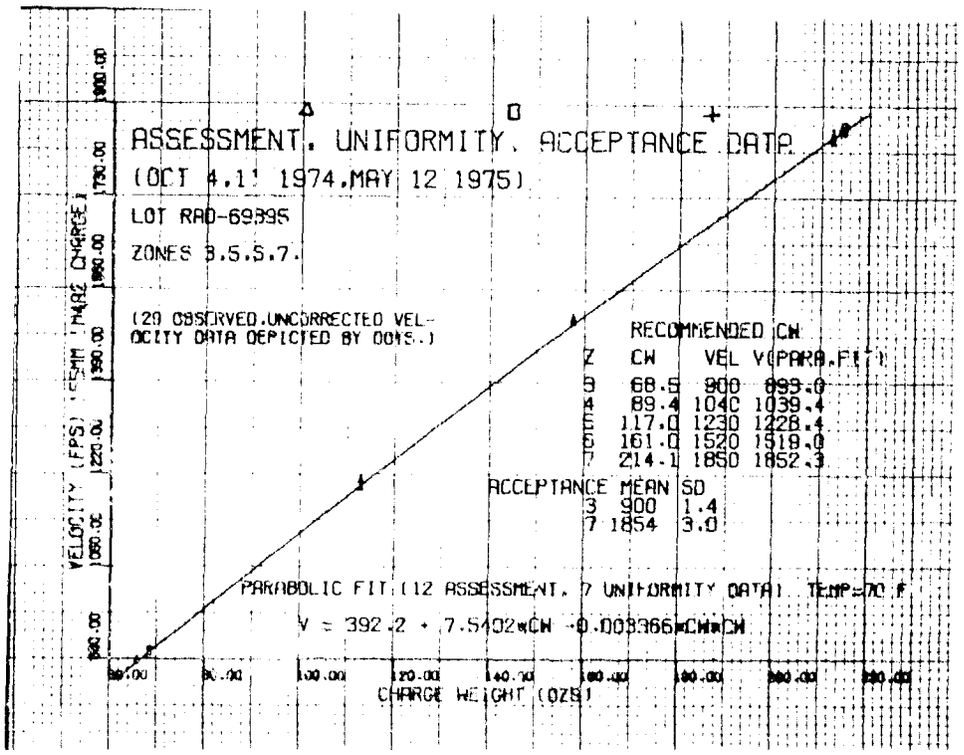


Figure 69 Lot Rad-69395 Ballistic Plot

Table 65 Jefferson PG Firing Record for Rad-69275

TESTING STATUS: First Test	DEPARTMENT OF THE ARMY JEFFERSON PROVING GROUND Madison, Indiana 47250	FIRING RECORD NO.: 74-1358
DATE (S) OF FIRING: 20, 24 May 74	ACCEPTANCE TEST SUMMARY	LOT NO.: RAD-69275
SHIPPING STATUS: Routine	ITEM DESCRIPTION: Propellant, MI, MP, F/Prop Chg M4A2 155mm Howitzer	TESTED IN ACCORDANCE WITH: BTR-ARMCOM-151-73
MFR. OR LOADING PLANT: Radford Army Ammo Plant		RESULTS OF TEST: Accepted

MEASURED CHARACTERISTICS (UNIFORMITY TEST)

Test or Characteristic	Temp	Calibration Rounds: Rds Cons	Mean	Max Disp	Std Dev	Test Rounds: Rds Cons	Chg Wt ozs	Obs Mean	Corr Mean	Max Disp	Std Dev	.69 X Std.Dev.
Muzzle Velocity fps	+70°F	7	1834	5	1.8	7	211.2	1825	1841	8	3.2	2.2
	+145°F	7	1866	4	1.9	7	211.2	1853	1846	10	3.2	
Chamber Pressure psi/100	+70°F	7	354	9	3.0	7		348	359	15	4.8	
	+145°F	7	373	15	5.7	7		362	362	10	3.6	

Test rounds at both +70°F & +145°F are corrected to the +70°F level. In addition to the calibration corrections the corrected velocity & pressure values for the test propellant at +145°F were obtained by applying +9 fps,+800 psi for the difference in charge weight between the uniformity series and final recommended charge.

RECOMMENDED CHARGE WEIGHT

Zone	Charge Weight ozs. Incr	Total	Muzzle Velocity fps	Chamber Pressure psi/100
3	66.0	66.0	900	73
4	19.9	85.9	1040	89
5	27.7	113.6	1230	124
6	44.4	158.0	1520	211
7	54.0	212.0	1850	367

ATTACHMENT: Propellant Description Sheet

CAUSE (S) OF REJECTION: None

SPECIFICATION: MIL-P-60397 (MU) dtd 14 Dec 66 W/EO's 49906-2, 51949-2, 52153-2, 53472-2, NOR-7000588-2

CORRECTION APPLIED: CALIBRATION

CHARGE ASSESSMENT PHASE

Zone	Vel fps Calib	Vel fps Corr	Press psi/100 Calib	Press psi/100 Corr
3	900	+13	71	+2
5	1230	+16	126	0
6	1520	-15	212	+10
7	1850	+11	365	+15
UNIFORMITY PHASE				
7	+70°F 1850	-16	365	+11
7	+145°F 1850	-16	365	-4

APPROVED FOR THE COMMANDING OFFICER: E. J. CHAMBERS, DIR, MATERIEL TESTING	TEST DIRECTOR B. Turner B. TURNER

AUTHORITY FOR TEST: USATECOM PROJECT NO. 2-MU-00[illegible]-004-010

DATE SAMPLES RECEIVED: 13 May 74

RELATED FIRING RECORD: RAD-69273, -69274

SHEET 1 OF

DISTRIBUTION

CYS	TO
3	JPG
1	ARMCOM, AMSAR-QAO
3	APG, AMSAA, AMXSY-R; STEAP-MT-G, Barnhart; STEAP-TL
3	Picatinny Ars., SARPA-QA-A-P; -QA-A-A, -ADEP-2
2	Radford Army Ammo Plant

STEJP-TD-D Form 201, 1 Nov 73 (AUTH: SOP STEJP-TD-9)

DEPARTMENT OF THE ARMY
JEFFERSON PROVING GROUND
Madison, Indiana 47250

LOT NO: RAD-69275
FIRING RECORD NO. 74-1358
SHEET 2 OF 4

WEAPON DATA

How	155mm	M1A1	No. 7805
Tube	155mm	M1A1	No. 11513
Carriage	155mm	M1A2	No. 4597
Recoil	155mm	M6A2	No. 6687

Tube Rd. No. 2683 corresponds to EFC Rd. No. 1265, and there is 80% life remaining. The wear is .008" when measured by a pullover gage at a position 30 inches from the rear face of the tube.

COMPONENT DATA

Component	Model	Lot No.
Propellant (Test .0374" web	M1	RAD-69275
Propellant (Calib) .034" web	M1	RAD-68308 RL
Projectile	M107	GIN-1-11 RL
Fuze	M48	Mixed
Primer	MK2A4	RVA-17-86 RL
Propellant Bag		IND-11-45

Flash reducer, 1 oz. potassium nitrate (attached to forward end of base incr.)
Igniter, 3.5 oz. of powder, igniter, clean burning (C81) Lot No. RAD-2-21 RL

PRESSURE GAGE DATA

Type: M-11 Chg 7,7X,6 Copper Lot: APG-1-70
Type: M-17 Chg 5.3 Copper Lot: APG-1-70

VELOCITY COIL DATA

20 May 74				
Gun to First Coil:	79.92'H	Form Factor:	.94G2	1850 fps
Between Coils:	77.28' SL		.90G2	1520 fps
24 May 74			.86G2	1230 fps
Gun to First Coil:	79.90'H		.85G2	900 fps
Between Coils:	77.05' SL			

LEGEND: W - Warmer, Cond - Conditioner, Calib - Calibration,
H - Horizontal, SL - Slant

GUNNER LEADER: F. Jones

DEPARTMENT OF THE ARMY
JEFFERSON PROVING GROUND
Madison, Indiana 47250

LOT NO: RAD-69275
FIRING RECORD NO. 74-1358
SHEET 3 OF 4

CHARGE ASSESSMENT PHASE
+70°F

Firing Position: K-4 Azimuth: 0° 43' Elevation (mils): 213

Tube Rd No	Time of Firing	Type of Round	Prop Box No	Proj Wt lbs	Prop Chg ozs	Muzzle Vel (fps) Obs	Muzzle Vel (fps) Corr	Chamber Pressure psi/100 Obs	Chamber Pressure psi/100 Corr
Date Fired: 20 May 74									
2535	0939	W		95.00	212.4	1842			
2536	0941	W		"	"	1848			
2537	0942	Cond		"	"	1835		347	
2538	0943	7-Calib		95.00	212.4	1842		356	
2542	0950	"		"	"	1838		347	
2546	0954	"		"	"	1837		346	
2541	0949	7-Test	7-C	95.00	212.4	1839	1850	348	363
2545	0953	"	120-B	"	"	1840	1851	351	366
2549	0958	"	165-A	"	"	1842	1853	354	369
2552	1002	7X-Test	409-C	95.00	222.9	1914	1925	407	422
2555	1005	"	452-B	"	"	1912	1923	399	414
2558	1009	"	464-A	"	"	1911	1922	398	413
2559	1011	6-Calib		95.00	157.4	1505		203	
2563	1016	"		"	"	1501		200	
2567	1021	"		"	"	1508		204	
2562	1014	6-Test	828-C	95.00	157.4	1503	1518	202	212
2566*	1020	"	7-C	"	"	1451		175	
2570	1025	"	120-B	"	"	1507	1522	204	214
2571	1026	5-Calib		95.00	112.8	1214		127	
2575	1031	"		"	"	1209		124	
2579	1035	"		"	"	1218		126	
2574	1030	5-Test	165-A	95.00	112.8	1208	1224	124	124
2578	1034	"	409-C	"	"	1210	1226	124	124
2582	1039	"	452-B	"	"	1209	1225	125	125
2583	1040	3-Cond		95.00	65.6	883		70	
2584	1042	3-Calib		"	"	885		69	
2588	1047	"		"	"	889		68	
2592	1052	"			"	888		69	
2587	1045	3-Test	464-A	95.00	65.6	878	891	67	69
2591	1050	"	828-C	"	"	886	899	69	71
2595	1055	"	7-C	"	"	887	900	70	72

* Rd. 2566, velocity & pressures were not included in computations
At 0900 hours, ambient temperature was 69.5°F, humidity was 76%.
At 1000 hours, ambient temperature was 74.3°F, humidity was 69%

DEPARTMENT OF THE ARMY
JEFFERSON PROVING GROUND
Madison, Indiana 47250

LOT NO: RAD-69275
FIRING RECORD NO. 74-1358
SHEET 4 OF 4

UNIFORMITY PHASE

Firing Position: K-4 Azimuth: 0° 43' Elevation mils: 213

Tube Rd No	Time of Firing	Type of Round	Prop Box No	Proj Wt lbs	Prop Chg ozs	Muzzle Vel (fps) Obs	Muzzle Vel (fps) Corr	Chamber Press psi/100 Obs	Chamber Press psi/100 Corr
Date Fired: 24 May 74									
					+70°F				
2684	0857	W		95.00	212.4	1827			
2685	0858	W		"	"	1836			
2686	0859	Cond		"	"	1834		354	
2687	0900	Calib		95.00	212.4	1835		356	
2691	0905	"		"	"	1834		354	
2695	0909	"		"	"	1834		352	
2699	0915	"		"	"	1835		353	
2703	0920	"		"	"	1837		359	
2707	0924	"		"	"	1832		352	
2711	0928	"		"	"	1832		350	
2690	0903	Test	7-C	95.00	211.2	1827	1843	349	360
2694	0908	"	120-B	"	"	1824	1840	350	361
2698	0914	"	165-A	"	"	1828	1844	355	366
2702	0919	"	409-C	"	"	1829	1845	352	363
2706	0923	"	452-B	"	"	1821	1837	347	358
2710	0928	"	464-A	"	"	1821	1837	340	351
2714	0932	"	828-C	"	"	1824	1840	346	357
					+145°F				
2715	0935	Cond		95.00	212.4	868		376	
2716	0936	Calib		"	"	1867		379	
2720	0942	"		"	"	1868		377	
2724	0946	"		"	"	1865		379	
2728	0951	"		"	"	1868		377	
2732	0955	"		"	"	1864		374	
2736	0959	"		"	"	1864		364	
2740	1004	"		"	"	1864		368	
2719	0941	Test	7-C	95.00	211.2	1857	1850	360	360
2723	0945	"	120-B	"	"	1855	1848	360	360
2727	0949	"	165-A	"	"	1854	1847	364	364
2731	0954	"	409-C	"	"	1855	1848	365	365
2735	0958	"	452-B	"	"	1852	1845	362	362
2739	1003	"	464-A	"	"	1847	1840	355	355
2743	1007	"	828-C	"	"	1854	1847	365	365

At 0900 hours, ambient temperature was 65°F, humidity was 79%.

DEPARTMENT OF THE ARMY
JEFFERSON PROVING GROUND
Madison, Indiana 47250

LOT NO: RAD-69275
FIRING RECORD NO. 74-17
SHEET 3 OF 4

(ACCEPTANCE)

+70°F PHASE

Firing Position: K-4 Azimuth: 0° 01' Az Defl mils: 43R Elev: 216 mils

Rd No	Time of Firing	Type Rd	Gross Wt (lb)	Recoil in	Proj Seating in	Muzzle Vel fps Uncorr	Muzzle Vel fps Corr	Pressure psi/100 Uncorr
Date Fired: 15 Jul 7-								
				CHARGE III				
2169		Cond	4.48	35.00	30.88	Lost		92
2170	1035	"	"	"	"	949		95
2171	1036	"	4.49	"	"	982		111
2172	1038	"	"	"	"	939		91
2173	1039	"	4.48	"	"	1014		132
2174	1040	Ref	4.46	35.00	30.88	968		103
2176	1042	"	"	"	"	943		91
2178	1044	"	"	"	"	933		86
2180	1045	"	"	"	"	937		88
2182	1047	"	"	"	"	923		83
2175	1041	Test	4.48	35.00	30.88	970	929	104
2177	1043	"	"	"	"	933	892	88
2179	1044	"	"	"	"	935	894	89
2181	1046	"	"	"	"	939	898	90
2183	1048	"	"	"	"	922	881	84
				CHARGE VII				
2154	0848	Cond	13.70	60.50	30.88	1849		379
2155	0849	"	"	"	"	1848		381
2156	0901	"	"	"	"	1857		387
2157	0902	"	13.84	"	"	1848		368
2158	0903	"	"	"	"	1347		358
2159	0905	Ref	13.84	60.50	30.88	1848		365
2161	0909	"	"	"	"	1849		363
2163	0913	"	"	"	"	1845		363
2165	0917	"	"	"	"	1846		362
2167	0921	"	"	"	"	1846		362
2160	0907	Test	13.80	60.50	30.88	1846	1849	368
2162	0911	"	"	"	"	1843	1846	364
2164	0915	"	"	"	"	1848	1851	370
2166	0919	"	13.79	"	"	1847	1850	371
2168	0923	"	"	"	"	1841	1844	361

Rd No's. 2149 thru 2153 were fired as Pre-Conditioners.

NOTE: Zone Three charge was fired immediately following rain shower and erratic vel & pressure observed are attributed to atmospheric condition.

APPENDIX B Radford and Picatinny Closed Bomb Records

RADFORD Closed bomb Records for AUTOCAP lots J through W with reference lot 68308 (M1MP propellant for M4A2 charge, 155mm):

Units: Kpsi
Sample Interval: 0.2 milliseconds

The data (156 records) are only the first 90 points of each 123 point record. These 90 points go beyond peak pressure in each record. This data is SMOOTH data that was reported to two decimal place accuracy. The Radford RC algorithm can be used on these records to produce the unsmooth data by the relations:

$$P_o = \bar{P}_o$$

$$P_i = (4\ \bar{P}_i - \bar{P}_{i-1})/3$$

where the overhead bar refers to the SMOOTH DATA listed. The six hex records listed here are also SMOOTH data. In RQ calculation, the same firing number records are used.

PICATINNY Closed Bomb Records for Selected J through W lots.

Units: Kpsi
Sample Interval: 0.096 milliseconds

The data (39 records) as listed is the UNSMOOTH data derived directly from the A/D converter output. Much of the data beyond peak pressure has been omitted. No mixture lots, no M or N lots, nor reference lot 68308 were fired.

These records have also been corrected by a reasonable linear interpolation for those data points where the "A/D converter hang" occurred, as described in this report.

NOTE:

FOR ALL CLOSED BOMB PLOTS (DP/DT vs P) IN THIS REPORT (except those showing repeated smoothing, Figures 57-61), IN WHICH THE LEAST SQUARES METHOD IS EMPLOYED:

1) THE PRESSURE P IS DERIVED FROM THE SMOOTHING ALGORITHM APPLIED TO THE UNSMOOTH RAW PRESSURE DATA;

2) THE DERIVATIVE DP/DT IS DERIVED FROM APPLYING THE DERIVATIVE ALGORITHM TO THE UNSMOOTH RAW PRESSURE DATA, AS SHOWN IN THE ROUTINE ON PAGE 34.

Smoother plots result (without sacrificing physically significant features) by applying the derivative algorithm to the raw data AFTER it has been subjected once to the smoothing algorithm (See page 36). This was the approach used for the RAD RC plots.

AUTOCAP LOT J. RAD FIRING NO. 1

.62	.61	.68	.69	.73	.81	.83	.91	.97	1.04	1.09
1.14	1.21	1.32	1.37	1.49	1.58	1.68	1.83	1.94	2.08	2.28
2.44	2.67	2.88	3.12	3.39	3.63	3.91	4.17	4.44	4.76	5.05
5.36	5.71	6.04	6.43	6.79	7.18	7.62	8.04	8.47	8.96	9.42
9.96	10.47	11.02	11.62	12.20	12.88	13.55	14.25	15.03	15.82	16.63
17.57	18.50	19.50	20.52	21.58	22.69	23.76	24.79	25.75	26.57	27.26
27.81	28.24	28.55	28.80	28.99	29.11	29.20	29.26	29.30	29.32	29.34
29.35	29.37	29.38	29.38	29.39	29.39	29.40	29.39	29.40	29.39	29.39

AUTOCAP LOT J. RAD FIRING NO. 2

.62	.69	.70	.74	.82	.84	.89	.98	1.01	1.10	1.14
1.21	1.31	1.37	1.45	1.58	1.65	1.78	1.88	2.00	2.18	2.32
2.53	2.72	2.94	3.20	3.43	3.69	3.97	4.23	4.54	4.82	5.13
5.48	5.79	6.17	6.53	6.90	7.32	7.73	8.17	8.66	9.10	9.61
10.11	10.64	11.22	11.79	12.42	13.09	13.78	14.52	15.28	16.10	16.98
17.88	18.87	19.86	20.91	22.00	23.10	24.19	25.24	26.18	27.01	27.67
28.20	28.61	28.91	29.14	29.31	29.42	29.50	29.54	29.58	29.60	29.61
29.63	29.64	29.64	29.66	29.64	29.65	29.66	29.66	29.66	29.66	29.65

AUTOCAP LOT J. RAD FIRING NO. 3

.84	.84	.89	.91	.97	1.03	1.05	1.13	1.18	1.25	1.31
1.35	1.41	1.51	1.58	1.68	1.76	1.87	2.01	2.12	2.27	2.45
2.62	2.85	3.06	3.28	3.55	3.79	4.05	4.35	4.60	4.93	5.21
5.52	5.88	6.20	6.59	6.95	7.33	7.78	8.18	8.63	9.12	9.58
10.12	10.63	11.18	11.79	12.38	13.03	13.73	14.43	15.21	16.00	16.85
17.78	18.71	19.73	20.75	21.83	22.95	24.04	25.11	26.10	26.95	27.67
28.23	28.66	29.00	29.24	29.43	29.55	29.64	29.69	29.74	29.76	29.77
29.79	29.80	29.81	29.82	29.82	29.82	29.82	29.81	29.82	29.81	29.81

AUTOCAP LOT J. RAD FIRING NO. 4

.68	.68	.74	.76	.79	.87	.90	.98	1.01	1.07	1.15
1.20	1.28	1.40	1.47	1.58	1.66	1.76	1.92	2.03	2.18	2.38
2.55	2.79	2.99	3.22	3.50	3.74	4.02	4.27	4.55	4.87	5.16
5.48	5.84	6.17	6.55	6.91	7.31	7.76	8.17	8.62	9.11	9.58
10.10	10.61	11.18	11.78	12.38	13.06	13.72	14.45	15.27	16.05	16.90
17.82	18.76	19.77	20.80	21.88	22.99	24.06	25.08	26.02	26.84	27.49
28.00	28.40	28.70	28.92	29.09	29.20	29.27	29.32	29.36	29.38	29.43
29.41	29.42	29.42	29.43	29.43	29.43	29.43	29.44	29.43	29.43	29.43

AUTOCAP LOT J. RAD FIRING NO. 5

.73	.73	.79	.80	.84	.91	.94	.99	1.08	1.11	1.20
1.25	1.31	1.43	1.49	1.58	1.72	1.81	1.95	2.06	2.21	2.41
2.57	2.82	3.02	3.25	3.54	3.78	4.05	4.35	4.61	4.94	5.24
5.57	5.93	6.26	6.63	7.05	7.43	7.88	8.29	8.75	9.25	9.72
10.26	10.79	11.36	11.96	12.58	13.25	13.97	14.70	15.51	16.31	17.18
18.14	19.09	20.11	21.17	22.26	23.36	24.43	25.45	26.36	27.13	27.76
28.26	28.63	28.92	29.14	29.30	29.40	29.47	29.52	29.55	29.57	29.59
29.59	29.60	29.62	29.62	29.62	29.63	29.63	29.63	29.62	29.62	29.62

AUTOCAP LOT J. RAD FIRING NO. 6

.69	.68	.71	.78	.80	.88	.90	.94	1.03	1.00	1.10
1.22	1.28	1.38	1.44	1.53	1.66	1.74	1.87	2.03	2.16	2.35
2.51	2.72	2.97	3.18	3.45	3.69	3.95	4.24	4.50	4.80	5.14
5.42	5.79	6.12	6.48	6.89	7.28	7.72	8.16	8.60	9.08	9.56
10.07	10.62	11.17	11.78	12.39	13.06	13.76	14.48	15.26	16.10	16.96
17.89	18.85	19.86	20.92	22.00	23.11	24.19	25.22	26.14	26.94	27.59
28.11	28.51	28.81	29.03	29.18	29.30	29.38	29.42	29.47	29.50	29.51
29.52	29.53	29.55	29.55	29.55	29.55	29.55	29.56	29.56	29.55	29.56

AUTOCAP LOT K. RAD FIRING NO. 1

.89	.92	1.00	1.03	1.11	1.15	1.20	1.30	1.34	1.41	1.51
1.57	1.67	1.74	1.82	1.95	2.03	2.13	2.27	2.37	2.52	2.65
2.81	3.04	3.22	3.47	3.70	3.92	4.19	4.44	4.71	5.04	5.33
5.67	5.99	6.34	6.72	7.08	7.47	7.91	8.31	8.77	9.22	9.71
10.24	10.74	11.33	11.92	12.55	13.24	13.93	14.68	15.48	16.30	17.19
18.10	19.08	20.12	21.19	22.29	23.39	24.42	25.35	26.13	26.77	27.29
27.69	28.02	28.25	28.42	28.56	28.64	28.69	28.72	28.75	28.77	28.78
28.79	28.80	28.81	28.81	28.82	28.81	28.82	28.79	28.80	28.81	28.80

AUTOCAP LOT K. RAD FIRING NO. 2

.90	.92	.98	1.01	1.00	1.14	1.18	1.28	1.35	1.39	1.49
1.54	1.62	1.73	1.80	1.93	2.01	2.11	2.26	2.36	2.48	2.68
2.84	3.06	3.24	3.46	3.73	3.95	4.23	4.48	4.75	5.07	5.36
5.68	6.04	6.37	6.74	7.11	7.50	7.94	8.34	8.78	9.27	9.73
10.25	10.72	11.33	11.97	12.59	13.28	13.98	14.73	15.53	16.36	17.25
18.19	19.17	20.22	21.31	22.54	23.55	24.61	25.58	26.38	27.05	27.58
28.00	28.32	28.56	28.72	28.84	28.92	28.96	29.00	29.01	29.03	29.04
29.04	29.06	29.06	29.06	29.06	29.06	29.06	29.06	29.05	29.05	29.04

AUTOCAP LOT K. RAD FIRING NO. 3

.88	.95	.97	1.02	1.11	1.15	1.21	1.31	1.35	1.45	1.50
1.58	1.69	1.76	1.88	1.95	2.04	2.18	2.26	2.38	2.54	2.66
2.86	3.02	3.22	3.48	3.68	3.92	4.21	4.45	4.76	5.03	5.33
5.68	5.99	6.37	6.70	7.07	7.50	7.88	8.29	8.75	9.19	9.70
10.18	10.70	11.28	11.86	12.49	13.18	13.86	14.63	15.40	16.23	17.13
18.03	19.02	20.04	21.13	22.27	23.40	24.49	25.51	26.36	27.06	27.6
28.07	28.41	28.66	28.85	28.98	29.07	29.11	29.15	29.18	29.19	29.20
29.20	29.22	29.23	29.22	29.23	29.23	29.23	29.22	29.22	29.22	29.22

AUTOCAP LOT K. RAD FIRING NO. 4

.90	.97	1.06	1.08	1.17	1.20	1.25	1.35	1.39	1.45	1.57
1.61	1.72	1.77	1.85	1.98	2.05	2.15	2.29	2.39	2.54	2.67
2.85	3.07	3.26	3.50	3.71	3.95	4.23	4.48	4.76	5.08	5.36
5.70	6.01	6.39	6.76	7.12	7.51	7.94	8.35	8.73	9.24	9.75
10.27	10.79	11.38	11.97	12.61	13.30	14.00	14.75	15.56	16.38	17.28
18.21	19.19	20.23	21.31	22.41	23.52	24.57	25.52	26.31	26.96	27.49
27.90	28.21	28.43	28.60	28.73	28.80	28.84	28.88	28.90	28.92	28.94
28.94	28.94	28.96	28.95	28.95	28.95	28.99	28.96	28.94	28.95	28.94

AUTOCAP LOT K. RAD FIRING NO. 5

.99	.99	1.05	1.08	1.12	1.21	1.25	1.34	1.38	1.43	1.54
1.59	1.67	1.78	1.84	1.96	2.03	2.14	2.27	2.35	2.50	2.64
2.76	2.97	3.14	3.40	3.62	3.83	4.10	4.34	4.60	4.93	5.21
5.52	5.87	6.18	6.58	6.92	7.30	7.72	8.11	8.54	9.01	9.47
9.98	10.47	11.02	11.62	12.21	12.87	13.55	14.26	15.04	15.84	16.68
17.59	18.53	19.55	20.60	21.69	22.82	23.91	24.94	25.84	26.60	27.22
27.71	28.09	28.37	28.59	28.74	28.84	28.91	28.94	28.97	28.99	29.00
29.02	29.02	29.03	29.03	29.03	29.03	29.03	29.03	29.03	29.02	29.02

AUTOCAP LOT K. RAD FIRING NO. 6

.86	.92	.95	1.03	1.07	1.12	1.21	1.26	1.32	1.43	1.47
1.55	1.64	1.72	1.85	1.92	2.02	2.15	2.25	2.39	2.50	2.67
2.87	3.05	3.29	3.49	3.72	4.00	4.23	4.50	4.81	5.08	5.42
5.72	6.05	6.43	6.78	7.18	7.57	7.96	8.41	8.83	9.28	9.79
10.29	10.85	11.41	12.00	12.66	13.32	14.02	14.80	15.59	16.45	17.33
18.26	19.26	20.31	21.42	22.52	23.63	24.69	25.63	26.41	27.06	27.56
27.97	28.29	28.52	28.69	28.81	28.88	28.93	28.97	28.99	29.00	29.01
29.03	29.03	29.04	29.04	29.04	29.04	29.04	29.04	29.03	29.03	29.03

AUTOCAP LOT L. RAD FIRING NO. 1

1.02	1.05	1.06	1.15	1.18	1.27	1.31	1.36	1.46	1.50	1.60
1.64	1.71	1.83	1.89	1.97	2.10	2.17	2.30	2.39	2.50	2.65
2.78	2.94	3.15	3.34	3.58	3.79	4.04	4.32	4.56	4.88	5.16
5.48	5.84	6.19	6.55	6.96	7.34	7.78	8.20	8.65	9.14	9.63
10.14	10.70	11.24	11.85	12.45	13.12	13.80	14.52	15.31	16.10	16.95
17.86	18.81	19.84	20.91	21.99	23.08	24.12	25.07	25.90	26.59	27.14
27.59	27.94	28.21	28.41	28.54	28.64	28.70	28.74	28.76	28.78	28.80
28.80	28.82	28.82	28.82	28.83	28.82	28.82	28.82	28.81	28.81	28.81

AUTOCAP LOT L. RAD FIRING NO. 2

1.00	1.07	1.09	1.14	1.23	1.28	1.33	1.40	1.44	1.56	1.61
1.69	1.79	1.86	1.92	2.03	2.13	2.26	2.34	2.45	2.61	2.73
2.90	3.06	3.26	3.50	3.70	3.92	4.20	4.45	4.71	5.01	5.31
5.66	5.97	6.35	6.71	7.09	7.51	7.91	8.35	8.83	9.28	9.79
10.29	10.81	11.39	11.96	12.60	13.25	13.92	14.65	15.39	16.20	17.07
17.97	18.95	19.93	21.00	22.10	23.19	24.23	25.20	26.01	26.71	27.26
27.70	28.06	28.32	28.52	28.65	28.74	28.81	28.84	28.87	28.88	28.89
28.90	28.90	28.90	28.91	28.91	28.91	28.91	28.90	28.91	28.90	28.90

AUTOCAP LOT L. RAD FIRING NO. 3

1.00	1.03	1.12	1.16	1.25	1.28	1.35	1.46	1.51	1.61	1.66
1.73	1.84	1.91	2.00	2.12	2.20	2.32	2.41	2.51	2.67	2.79
2.92	3.12	3.30	3.54	3.74	3.97	4.25	4.49	4.79	5.07	5.38
5.73	6.06	6.43	6.84	7.21	7.66	8.06	8.50	8.99	9.45	9.95
10.51	11.04	11.63	12.22	12.85	13.56	14.23	15.01	15.77	16.59	17.50
18.42	19.43	20.49	21.56	22.68	23.73	24.76	25.68	26.42	27.06	27.56
27.94	28.24	28.47	28.63	28.75	28.82	28.87	28.89	28.90	28.92	28.93
28.93	28.93	28.94	28.94	28.94	28.93	28.93	28.92	28.92	28.92	28.91

AUTOCAP LOT L. RAD FIRING NO. 4

.89	.97	1.00	1.04	1.13	1.16	1.22	1.32	1.36	1.46	1.50
1.58	1.68	1.74	1.86	1.92	2.02	2.15	2.23	2.34	2.48	2.60
2.78	2.93	3.11	3.35	3.53	3.76	4.04	4.27	4.57	4.83	5.13
5.47	5.79	6.16	6.50	6.87	7.31	7.70	8.12	8.62	9.04	9.55
10.04	10.56	11.14	11.70	12.31	12.97	13.64	14.38	15.12	15.92	16.78
17.68	18.65	19.64	20.71	21.83	22.94	23.98	25.02	25.88	26.60	27.20
27.68	28.03	28.34	28.57	28.72	28.83	28.89	28.93	28.96	28.98	28.99
29.00	29.01	29.02	29.02	29.02	29.01	29.02	29.01	29.01	29.00	28.99

AUTOCAP LOT L. RAD FIRING NO. 5

1.01	1.07	1.11	1.16	1.25	1.29	1.37	1.42	1.48	1.59	1.63
1.70	1.82	1.87	1.99	2.05	2.15	2.28	2.36	2.50	2.60	2.72
2.91	3.05	3.24	3.48	3.68	3.95	4.17	4.43	4.74	5.01	5.31
5.67	5.99	6.37	6.72	7.11	7.54	7.96	8.41	8.85	9.33	9.86
10.35	10.88	11.47	12.05	12.70	13.34	14.03	14.78	15.55	16.37	17.27
18.18	19.17	20.20	21.28	22.38	23.47	24.49	25.43	26.22	26.88	27.41
27.84	28.17	28.42	28.60	28.74	28.82	28.87	28.91	28.93	28.94	28.96
28.96	28.97	28.97	28.98	28.97	28.97	28.97	28.97	28.96	28.95	28.95

AUTOCAP LOT L. RAD FIRING NO. 6

.98	.99	1.03	1.13	1.16	1.25	1.29	1.35	1.45	1.50	1.57
1.68	1.74	1.85	1.91	2.00	2.13	2.21	2.34	2.43	2.57	2.72
2.85	3.01	3.22	3.41	3.65	3.86	4.10	4.38	4.63	4.93	5.25
5.55	5.90	6.24	6.60	7.02	7.40	7.85	8.26	8.71	9.20	9.67
10.18	10.74	11.27	11.88	12.47	13.10	13.81	14.52	15.30	16.12	16.95
17.87	18.82	19.84	20.94	22.04	23.16	24.19	25.15	25.97	26.65	27.21
27.66	27.99	28.27	28.46	28.60	28.69	28.74	28.78	28.79	28.81	28.82
28.83	28.82	28.84	28.83	28.83	28.83	28.82	28.83	28.82	28.81	28.81

AUTOCAP LOT JL. RAD FIRING NO. 1

.81	.85	.90	.94	.99	1.07	1.09	1.19	1.24	1.31	1.41
1.46	1.53	1.64	1.71	1.83	1.91	2.01	2.16	2.27	2.43	2.57
2.74	2.96	3.15	3.36	3.61	3.82	4.10	4.34	4.61	4.93	5.21
5.56	5.90	6.23	6.62	6.99	7.38	7.82	8.24	8.71	9.16	9.65
10.18	10.69	11.23	11.85	12.45	13.12	13.80	14.52	15.31	16.11	16.99
17.91	18.86	19.89	20.94	22.05	23.16	24.21	25.18	26.00	26.69	27.25
27.69	28.03	28.31	28.51	28.65	28.74	28.80	28.85	28.88	28.90	28.91
28.93	28.93	28.94	28.94	28.94	28.94	28.94	28.94	28.94	28.93	28.94

AUTOCAP LOT JL. RAD FIRING NO. 2

.83	.83	.93	.95	1.02	1.05	1.10	1.20	1.24	1.30	1.40
1.46	1.57	1.62	1.70	1.84	1.92	2.06	2.15	2.27	2.45	2.59
2.77	3.01	3.20	3.44	3.65	3.90	4.18	4.43	4.74	5.03	5.32
5.67	5.98	6.34	6.74	7.11	7.53	7.94	8.38	8.86	9.26	9.80
10.35	10.89	11.47	12.05	12.68	13.36	14.05	14.81	15.59	16.41	17.31
18.23	19.22	20.27	21.34	22.45	23.53	24.57	25.53	26.32	26.98	27.53
27.95	28.29	28.53	28.71	28.84	28.91	28.97	29.00	29.02	29.04	29.05
29.05	29.06	29.05	29.06	29.06	29.06	29.06	29.05	29.05	29.07	29.05

AUTOCAP LOT JL. RAD FIRING NO. 3

.84	.88	.96	.98	1.06	1.09	1.14	1.24	1.27	1.37	1.42
1.51	1.60	1.66	1.71	1.86	1.94	2.07	2.16	2.28	2.45	2.58
2.75	2.96	3.15	3.38	3.59	3.82	4.10	4.35	4.63	4.92	5.22
5.56	5.88	6.23	6.62	7.00	7.42	7.82	8.23	8.68	9.18	9.69
10.19	10.72	11.28	11.85	12.47	13.14	13.82	14.56	15.31	16.13	17.00
17.91	18.88	19.92	20.98	22.09	23.19	24.27	25.28	26.14	26.88	27.47
27.94	28.32	28.60	28.80	28.96	29.05	29.12	29.16	29.18	29.21	29.21
29.23	29.24	29.24	29.25	29.25	29.28	29.26	29.24	29.24	29.23	29.23

AUTOCAP LOT JL. RAD FIRING NO. 4

.75	.81	.82	.86	.94	.97	1.04	1.07	1.13	1.24	1.28
1.35	1.46	1.52	1.63	1.70	1.79	1.93	2.02	2.17	2.29	2.42
2.68	2.79	2.98	3.22	3.42	3.68	3.91	4.17	4.47	4.73	5.03
5.37	5.69	6.06	6.40	6.78	7.18	7.57	8.03	8.46	8.91	9.42
9.91	10.42	11.00	11.55	12.17	12.79	13.47	14.20	14.96	15.75	16.62
17.50	18.47	19.48	20.54	21.66	22.78	23.91	24.97	25.86	26.71	27.37
27.92	28.34	28.66	28.89	29.06	29.17	29.25	29.30	29.34	29.36	29.37
29.38	29.39	29.39	29.40	29.40	29.40	29.39	29.39	29.39	29.39	29.37

AUTOCAP LOT JL. RAD FIRING NO. 5

.83	.83	.87	.95	.98	1.07	1.11	1.17	1.27	1.32	1.42
1.48	1.56	1.68	1.74	1.84	1.96	2.04	2.18	2.28	2.41	2.59
2.73	2.90	3.14	3.33	3.58	3.78	4.03	4.32	4.57	4.88	5.17
5.48	5.84	6.21	6.55	6.95	7.32	7.76	8.17	8.61	9.10	9.57
10.08	10.63	11.16	11.76	12.35	13.00	13.69	14.40	15.18	15.97	16.82
17.74	18.69	19.69	20.76	21.85	22.96	24.04	25.04	25.90	26.65	27.26
27.75	28.13	28.42	28.64	28.79	28.89	28.95	29.00	29.03	29.05	29.06
29.08	29.07	29.10	29.09	29.09	29.08	29.08	29.07	29.07	29.06	29.06

AUTOCAP LOT JL. RAD FIRING NO. 6

.98	.94	.96	1.01	1.10	1.13	1.18	1.28	1.32	1.41	1.46
1.53	1.64	1.70	1.81	1.87	1.96	2.09	2.18	2.28	2.48	2.57
2.76	2.93	3.13	3.37	3.58	3.81	4.09	4.33	4.62	4.90	5.21
5.55	5.86	6.23	6.59	6.97	7.40	7.80	8.23	8.71	9.17	9.67
10.17	10.71	11.29	11.86	12.48	13.15	13.83	14.58	15.35	16.17	17.05
17.97	18.96	19.98	21.08	22.21	23.31	24.38	25.34	26.15	26.85	27.41
27.85	28.20	28.45	28.65	28.79	28.88	28.93	28.97	29.00	29.01	29.03
29.04	29.04	29.06	29.06	29.05	29.05	29.06	29.05	29.05	29.04	29.04

AUTOCAP LOT JKL. RAD FIRING NO. 1

.87	.91	.98	1.01	1.10	1.14	1.21	1.29	1.34	1.48	1.55
1.58	1.68	1.74	1.83	1.96	2.03	2.16	2.24	2.36	2.51	2.64
2.80	3.01	3.20	3.44	3.66	3.89	4.17	4.42	4.71	4.98	5.28
5.63	5.95	6.29	6.68	7.04	7.47	7.87	8.29	8.76	9.21	9.69
10.23	10.74	11.32	11.90	12.51	13.18	13.87	14.63	15.37	16.20	17.09
17.99	18.97	20.02	21.10	22.22	23.34	24.41	25.39	26.22	26.91	27.47
27.89	28.24	28.49	28.68	28.81	28.89	28.95	28.99	29.01	29.02	29.04
29.04	29.05	29.06	29.06	29.06	29.06	29.05	29.05	29.05	29.04	29.05

AUTOCAP LOT JKL. RAD FIRING NO. 2

.87	.90	.97	1.00	1.07	1.15	1.17	1.27	1.31	1.34	1.47
1.53	1.65	1.71	1.79	1.93	2.00	2.10	2.25	2.34	2.50	2.63
2.80	3.02	3.20	3.45	3.68	3.90	4.19	4.42	4.69	5.02	5.30
5.65	5.97	6.33	6.72	7.09	7.48	7.93	8.35	8.81	9.27	9.75
10.29	10.81	11.38	11.96	12.59	13.31	13.97	14.70	15.49	16.31	17.20
18.12	19.10	20.13	21.20	22.30	23.39	24.43	25.39	26.20	26.88	27.43
27.87	28.21	28.46	28.65	28.76	28.86	28.91	28.95	28.97	28.98	28.99
29.00	29.00	29.00	29.01	29.01	29.00	29.02	29.00	28.99	29.00	29.03

AUTOCAP LOT JKL. RAD FIRING NO. 3

.90	.97	1.04	1.08	1.10	1.15	1.25	1.29	1.36	1.46	1.51
1.61	1.67	1.75	1.87	1.94	2.06	2.14	2.24	2.39	2.49	2.64
2.84	3.00	3.24	3.44	3.67	3.93	4.17	4.43	4.74	5.02	5.35
5.66	5.99	6.38	6.73	7.13	7.51	7.94	8.39	8.84	9.30	9.83
10.33	10.89	11.45	12.05	12.70	13.36	14.07	14.82	15.60	16.44	17.31
18.26	19.26	20.29	21.38	22.49	23.58	24.64	25.57	26.36	27.01	27.52
27.93	28.24	28.47	28.64	28.75	28.83	28.88	28.91	28.94	28.95	28.96
28.96	28.98	28.98	28.98	28.97	28.99	28.98	28.97	28.98	28.97	28.97

AUTOCAP LOT JKL. RAD FIRING NO. 4

.98	.98	1.01	1.10	1.13	1.18	1.28	1.31	1.41	1.45	1.52
1.63	1.68	1.79	1.85	1.94	2.07	2.15	2.25	2.39	2.50	2.67
2.79	2.97	3.21	3.39	3.62	3.89	4.11	4.40	4.65	4.94	5.27
5.56	5.92	6.27	6.61	7.01	7.39	7.80	8.25	8.67	9.16	9.62
10.12	10.66	11.19	11.77	12.41	13.03	13.73	14.43	15.20	16.02	16.87
17.78	18.73	19.74	20.82	21.91	23.01	24.09	25.08	25.94	26.66	27.25
27.72	28.07	28.36	28.57	28.72	28.81	28.88	28.91	28.94	28.96	28.97
28.98	28.99	28.99	29.00	29.00	28.99	29.00	28.99	28.99	28.98	28.98

AUTOCAP LOT JKL. RAD FIRING NO. 5

.95	.96	1.03	1.05	1.11	1.19	1.22	1.27	1.37	1.42	1.51
1.57	1.64	1.74	1.82	1.93	2.00	2.10	2.23	2.33	2.45	2.62
2.76	2.96	3.14	3.34	3.60	3.79	4.05	4.34	4.58	4.89	5.16
5.48	5.84	6.16	6.56	6.91	7.30	7.74	8.14	8.59	9.07	9.54
10.06	10.57	11.12	11.72	12.31	12.96	13.66	14.37	15.14	15.92	16.77
17.69	18.64	19.67	20.72	21.82	22.93	24.00	25.01	25.87	26.60	27.21
27.69	28.07	28.36	28.58	28.74	28.87	28.91	28.95	29.01	29.01	29.01
29.02	29.03	29.03	29.04	29.04	29.04	29.03	29.03	29.03	29.02	29.03

AUTOCAP LOT JKL. RAD FIRING NO. 6

.89	.92	.93	1.00	1.03	1.09	1.17	1.22	1.31	1.36	1.43
1.54	1.60	1.68	1.80	1.88	2.00	2.08	2.18	2.33	2.43	2.60
2.77	2.93	3.16	3.34	3.57	3.84	4.06	4.36	4.60	4.90	5.22
5.53	5.83	6.22	6.57	6.98	7.37	7.77	8.22	8.65	9.16	9.63
10.13	10.89	11.23	11.82	12.47	13.11	13.82	14.55	15.33	16.17	17.03
17.95	18.94	19.95	21.05	22.16	23.29	24.38	25.37	26.22	26.93	27.59
27.95	28.31	28.58	28.77	28.92	29.01	29.07	29.11	29.14	29.14	29.17
29.17	29.18	29.19	29.21	29.19	29.19	29.20	29.19	29.19	29.18	29.18

AUTOCAP LOT JKLL. RAD FIRING NO. 1

.79	.86	.88	.95	.98	1.03	1.13	1.16	1.22	1.33	1.38
1.48	1.54	1.61	1.73	1.80	1.89	2.03	2.11	2.26	2.37	2.50
2.71	2.88	3.11	3.32	3.54	3.82	4.05	4.31	4.62	4.89	5.22
5.53	5.87	6.24	6.59	7.00	7.40	7.78	8.24	8.68	9.15	9.64
10.15	10.69	11.25	11.84	12.48	13.13	13.82	14.58	15.34	16.18	17.03
17.94	18.91	19.91	20.96	22.04	23.09	24.10	25.00	25.78	26.42	26.93
27.34	27.66	27.90	28.08	28.22	28.31	28.37	28.42	28.46	28.47	28.49
28.51	28.52	28.53	28.53	28.53	28.54	28.53	28.54	28.54	28.54	28.54

AUTOCAP LOT JKLL. RAD FIRING NO. 2

.84	.91	.93	1.00	1.03	1.08	1.17	1.21	1.26	1.36	1.41
1.52	1.56	1.64	1.76	1.83	1.96	2.05	2.16	2.32	2.44	2.60
2.82	3.00	3.24	3.44	3.68	3.94	4.17	4.44	4.75	5.02	5.35
5.67	5.99	6.37	6.72	7.12	7.50	7.89	8.35	8.77	9.23	9.73
10.21	10.76	11.28	11.87	12.50	13.13	13.84	14.56	15.31	16.13	16.96
17.86	18.82	19.81	20.86	21.91	22.98	24.01	24.94	25.74	26.40	26.93
27.37	27.70	27.95	28.15	28.28	28.38	28.44	28.48	28.51	28.53	28.54
28.55	28.57	28.57	28.61	28.58	28.57	28.57	28.56	28.56	28.55	28.55

AUTOCAP LOT JKLL. RAD FIR NG NO. 3

.85	.93	.95	1.03	1.06	1.10	1.20	1.24	1.30	1.41	1.46
1.57	1.63	1.71	1.84	1.91	2.01	2.15	2.24	2.39	2.51	2.66
2.86	3.04	3.23	3.48	3.72	3.99	4.23	4.49	4.80	5.07	5.40
5.71	6.04	6.42	6.76	7.15	7.57	7.96	8.43	8.85	9.31	9.83
10.32	10.86	11.42	12.00	12.64	13.30	13.99	14.73	15.49	16.32	17.16
18.08	19.05	20.05	21.10	22.18	23.24	24.26	25.16	25.93	26.58	27.09
27.50	27.80	28.04	28.21	28.34	28.42	28.49	28.51	28.55	28.56	28.58
28.58	28.59	28.59	28.59	28.59	28.59	28.59	28.59	28.60	28.60	28.59

AUTOCAP LOT JKLL. RAD FIRING NO. 4

.89	.92	1.00	1.03	1.07	1.16	1.20	1.29	1.32	1.39	1.49
1.55	1.64	1.70	1.78	1.91	1.98	2.07	2.21	2.31	2.46	2.58
2.75	2.97	3.16	3.41	3.64	3.85	4.13	4.37	4.63	4.95	5.24
5.58	5.90	6.24	6.62	6.99	7.37	7.82	8.21	8.68	9.12	9.60
10.13	10.63	11.20	11.76	12.38	13.07	13.74	14.46	15.26	16.04	16.90
17.80	18.75	19.77	20.82	21.90	23.00	24.06	25.02	25.85	26.54	27.10
27.53	27.87	28.13	28.33	28.47	28.56	28.62	28.66	28.69	28.70	28.71
28.73	28.73	28.76	28.74	28.74	28.74	28.74	28.74	28.74	28.74	28.74

AUTOCAP LOT JKLL. RAD FIRING NO. 5

.93	.96	1.00	1.07	1.10	1.19	1.23	1.30	1.40	1.45	1.53
1.64	1.70	1.81	1.88	1.97	2.11	2.19	2.32	2.42	2.65	2.75
2.88	3.06	3.29	3.50	3.75	3.96	4.22	4.51	4.78	5.09	5.41
5.71	6.06	6.40	6.76	7.17	7.55	7.98	8.39	8.84	9.33	9.80
10.31	10.87	11.43	12.03	12.64	13.30	14.01	14.73	15.51	16.31	17.18
18.11	19.07	20.08	21.15	22.24	23.32	24.34	25.27	26.07	26.71	27.23
27.64	27.95	28.19	28.37	28.49	28.57	28.62	28.65	28.68	28.68	28.71
28.71	28.72	28.72	28.72	28.72	28.72	28.73	28.72	28.72	28.71	28.72

AUTOCAP LOT JKLL. RAD FIRING NO. 6

.89	.96	.99	1.03	1.11	1.15	1.23	1.27	1.34	1.45	1.48
1.60	1.67	1.75	1.87	1.95	2.04	2.18	2.26	2.40	2.50	2.62
2.80	2.94	3.15	3.37	3.57	3.83	4.06	4.31	4.60	4.87	5.19
5.48	5.81	6.18	6.53	6.89	7.32	7.70	8.15	8.58	9.03	9.53
10.02	10.56	11.10	11.68	12.31	12.94	13.62	14.36	15.10	15.92	16.76
17.63	18.59	19.59	20.61	21.71	22.81	23.88	24.86	25.73	26.45	27.03
27.49	27.84	28.12	28.32	28.47	28.57	28.63	28.67	28.70	28.72	28.73
28.74	28.74	28.74	28.74	28.75	28.75	28.75	28.74	28.74	28.74	28.75

AUTOCAP LOT M. RAD FIRING NO. 1

.82	.86	.94	.97	1.06	1.09	1.15	1.25	1.30	1.37	1.48
1.54	1.65	1.72	1.82	1.95	2.05	2.17	2.33	2.47	2.67	2.84
3.05	3.30	3.51	3.77	4.00	4.26	4.55	4.83	5.12	5.45	5.76
6.12	6.45	6.81	7.22	7.61	8.06	8.51	8.95	9.46	9.95	10.48
11.06	11.64	12.27	12.90	13.58	14.31	15.05	15.82	16.65	17.49	18.38
19.27	20.18	21.08	21.97	22.84	23.67	24.49	25.28	26.01	26.67	27.24
27.70	28.09	28.37	28.60	28.76	28.86	28.94	29.02	29.02	29.04	29.05
29.06	29.07	29.06	29.07	29.06	29.06	29.06	29.06	29.06	29.05	29.06

AUTOCAP LOT M. RAD FIRING NO. 2

.88	.91	.99	1.01	1.06	1.15	1.18	1.27	1.31	1.37	1.47
1.52	1.62	1.69	1.77	1.89	1.97	2.07	2.21	2.31	2.49	2.61
2.79	3.03	3.24	3.48	3.76	4.00	4.30	4.57	4.89	5.21	5.51
5.87	6.23	6.61	7.02	7.40	7.84	8.32	8.78	9.30	9.81	10.36
10.94	11.54	12.16	12.82	13.50	14.24	14.98	15.76	16.60	17.45	18.36
19.28	20.21	21.15	22.05	22.95	23.82	24.70	25.47	26.20	26.88	27.47
27.95	28.34	28.65	28.88	29.04	29.15	29.21	29.26	29.29	29.31	29.32
29.33	29.34	29.34	29.34	29.34	29.34	29.34	29.33	29.33	29.32	29.32

AUTOCAP LOT M. RAD FIRING NO. 3

.83	.88	.94	.96	1.04	1.10	1.14	1.19	1.29	1.33	1.43
1.49	1.57	1.68	1.74	1.83	1.98	2.04	2.21	2.32	2.48	2.68
2.86	3.10	3.31	3.55	3.82	4.07	4.34	4.65	4.94	5.28	5.59
5.92	6.31	6.67	7.06	7.48	7.87	8.33	8.79	9.28	9.82	10.34
10.93	11.51	12.13	12.80	13.48	14.19	14.96	15.74	16.58	17.43	18.32
19.26	20.18	21.10	22.01	22.91	23.78	24.60	25.45	26.18	26.85	27.44
27.92	28.31	28.63	28.84	29.00	29.11	29.18	29.25	29.25	29.27	29.28
29.28	29.28	29.28	29.29	29.29	29.29	29.28	29.28	29.27	29.27	29.27

AUTOCAP LOT M. RAD FIRING NO. 4

.90	.90	.93	1.01	1.04	1.12	1.15	1.21	1.30	1.35	1.44
1.48	1.56	1.67	1.74	1.83	1.95	2.03	2.17	2.27	2.39	2.58
2.73	2.93	3.17	3.39	3.66	3.89	4.15	4.46	4.74	5.06	5.35
5.68	6.05	6.42	6.79	7.20	7.61	8.09	8.55	9.03	9.56	10.08
10.66	11.26	11.85	12.51	13.17	13.87	14.63	15.40	16.23	17.07	17.95
18.87	19.80	20.73	21.67	22.56	23.45	24.29	25.10	25.90	26.61	27.25
27.79	28.23	28.58	28.84	29.02	29.15	29.24	29.29	29.32	29.35	29.37
29.37	29.37	29.39	29.39	29.39	29.39	29.38	29.39	29.38	29.38	29.37

AUTOCAP LOT M. RAD FIRING NO. 5

.83	.86	.94	.97	1.02	1.10	1.14	1.22	1.26	1.33	1.43
1.48	1.56	1.68	1.74	1.87	1.96	2.06	2.21	2.32	2.50	2.65
2.85	3.09	3.29	3.53	3.81	4.05	4.36	4.62	4.91	5.23	5.52
5.85	6.25	6.59	6.99	7.37	7.78	8.25	8.69	9.18	9.66	10.18
10.76	11.32	11.94	12.59	13.24	13.96	14.68	15.45	16.26	17.09	17.98
18.89	19.79	20.71	21.60	22.47	23.35	24.17	24.98	25.76	26.46	27.08
27.61	28.00	28.37	28.63	28.82	28.95	29.03	29.09	29.12	29.14	29.16
29.17	29.18	29.18	29.18	29.18	29.19	29.19	29.19	29.18	29.18	29.17

AUTOCAP LOT M. RAD FIRING NO. 6

.95	.98	1.05	1.08	1.12	1.20	1.24	1.32	1.36	1.43	1.53
1.58	1.69	1.75	1.84	1.97	2.05	2.15	2.28	2.37	2.53	2.64
2.80	3.00	3.20	3.43	3.72	3.95	4.25	4.52	4.81	5.15	5.48
5.85	6.19	6.56	6.97	7.37	7.80	8.28	8.74	9.25	9.75	10.29
10.84	11.45	12.07	12.74	13.40	14.12	14.85	15.61	16.48	17.32	18.22
19.12	20.06	21.01	21.92	22.82	23.69	24.52	25.31	26.09	26.78	27.38
27.88	28.29	28.58	28.83	29.01	29.12	29.19	29.21	29.26	29.28	29.29
29.30	29.31	29.30	29.30	29.31	29.31	29.30	29.29	29.29	29.29	29.29

AUTOCAP LOT N. RAD FIRING NO. 1

.89	.89	.93	1.01	1.03	1.11	1.14	1.19	1.29	1.32	1.38
1.48	1.52	1.63	1.68	1.76	1.88	1.96	2.05	2.20	2.29	2.44
2.57	2.74	2.96	3.16	3.41	3.64	3.88	4.17	4.44	4.72	5.05
5.33	5.70	6.04	6.41	6.80	7.18	7.61	8.07	8.50	9.00	9.49
10.03	10.63	11.20	11.85	12.47	13.15	13.90	14.66	15.45	16.31	17.19
18.14	19.12	20.14	21.21	22.28	23.33	24.37	25.35	26.25	27.05	27.70
28.23	28.61	28.90	29.10	29.23	29.31	29.36	29.39	29.42	29.42	29.45
29.44	29.44	29.44	29.44	29.45	29.45	29.44	29.44	29.44	29.44	29.43

AUTOCAP LOT N. RAD FIRING NO. 2

.79	.78	.86	.87	.92	1.00	1.03	1.08	1.18	1.22	1.32
1.37	1.44	1.55	1.61	1.72	1.81	1.89	2.02	2.10	2.21	2.37
2.48	2.65	2.81	3.00	3.25	3.47	3.71	4.00	4.26	4.59	4.87
5.16	5.50	5.84	6.25	6.59	6.95	7.38	7.83	8.27	8.76	9.25
9.80	10.34	10.95	11.59	12.22	12.91	13.66	14.41	15.23	16.07	16.95
17.90	18.88	19.92	20.98	22.05	23.13	24.17	25.17	26.10	26.93	27.63
28.17	28.59	28.90	29.09	29.22	29.31	29.35	29.39	29.41	29.42	29.43
29.44	29.44	29.44	29.45	29.44	29.44	29.44	29.45	29.43	29.43	29.42

AUTOCAP LOT N. RAD FIRING NO. 3

.82	.82	.85	.93	.94	.99	1.08	1.12	1.21	1.25	1.31
1.41	1.47	1.58	1.63	1.71	1.85	1.93	2.02	2.17	2.27	2.42
2.55	2.71	2.94	3.13	3.36	3.62	3.86	4.14	4.40	4.68	5.02
5.30	5.64	5.97	6.33	6.74	7.11	7.52	7.98	8.42	8.90	9.38
9.91	10.48	11.04	11.67	12.33	13.00	13.74	14.49	15.29	16.14	17.02
17.96	18.93	19.96	21.02	22.07	23.13	24.16	25.15	26.08	26.89	27.57
28.12	28.54	28.83	29.03	29.14	29.23	29.28	29.32	29.34	29.35	29.36
29.36	29.37	29.37	29.37	29.36	29.37	29.37	29.37	29.36	29.35	29.35

AUTOCAP LOT N. RAD FIRING NO. 4

.78	.84	.86	.89	.97	.99	1.04	1.14	1.18	1.27	1.32
1.39	1.50	1.55	1.67	1.70	1.83	1.96	2.05	2.16	2.32	2.42
2.61	2.75	2.94	3.18	3.39	3.63	3.90	4.14	4.44	4.70	5.00
5.23	5.64	5.98	6.30	6.67	7.08	7.46	7.86	8.34	8.78	9.30
9.80	10.35	10.95	11.53	12.17	12.87	13.58	14.34	15.11	15.92	16.82
17.72	18.71	19.71	20.76	21.84	22.90	23.94	24.95	25.90	26.75	27.48
28.09	28.55	28.89	29.10	29.26	29.37	29.43	29.45	29.47	29.49	29.51
29.51	29.51	29.52	29.52	29.52	29.52	29.52	29.51	29.50	29.51	29.50

AUTOCAP LOT N. RAD FIRING NO. 5

.86	.86	.92	.94	.97	1.06	1.07	1.13	1.23	1.23	1.34
1.40	1.47	1.53	1.63	1.72	1.84	1.92	2.04	2.13	2.24	2.39
2.50	2.68	2.84	3.05	3.30	3.52	3.77	4.07	4.32	4.63	4.91
5.22	5.58	5.92	6.28	6.69	7.06	7.50	7.93	8.40	8.91	9.39
9.94	10.49	11.08	11.71	12.31	13.02	13.76	14.51	15.32	16.14	17.02
17.95	18.92	19.94	20.99	22.04	23.09	24.10	25.09	26.01	26.82	27.51
28.05	28.47	28.75	28.96	29.10	29.17	29.22	29.25	29.27	29.28	29.30
29.32	29.32	29.31	29.31	29.31	29.31	29.31	29.31	29.31	29.30	29.29

AUTOCAP LOT N. RAD FIRING NO. 6

.68	.75	.77	.80	.88	.91	.96	1.02	1.07	1.16	1.23
1.28	1.38	1.43	1.54	1.60	1.70	1.82	1.91	2.02	2.17	2.28
2.44	2.58	2.76	2.99	3.19	3.42	3.70	3.94	4.24	4.49	4.78
5.11	5.40	5.75	6.08	6.45	6.88	7.26	7.68	8.15	8.60	9.11
9.60	10.13	10.73	11.33	11.97	12.66	13.36	14.11	14.88	15.72	16.60
17.50	18.47	19.48	20.51	21.59	22.66	23.71	24.74	25.69	26.54	27.31
27.94	28.42	28.77	29.02	29.18	29.29	29.35	29.40	29.42	29.43	29.44
29.45	29.46	29.46	29.47	29.46	29.46	29.46	29.46	29.46	29.46	29.45

AUTOCAP LOT P. RAD FIRING NO. 1

1.12	1.21	1.24	1.29	1.41	1.47	1.57	1.63	1.72	1.84	1.93
2.03	2.17	2.28	2.45	2.58	.75	2.96	3.14	3.36	3.54	3.76
3.98	4.21	4.42	4.70	4.92	5.21	5.46	5.74	6.06	6.36	6.65
7.02	7.33	7.71	8.06	8.44	8.87	9.26	9.73	10.17	10.64	11.16
11.65	12.18	12.76	13.32	13.96	14.58	15.25	15.95	16.67	17.42	18.25
19.07	19.95	20.86	21.80	22.78	23.74	24.70	25.58	26.37	27.05	27.61
28.07	28.44	28.74	28.96	29.13	29.27	29.37	29.45	29.48	29.52	29.54
29.51	29.54	29.56	29.57	29.58	29.57	29.58	29.57	29.57	29.57	29.57

AUTOCAP LOT P. RAD FIRING NO. 2

1.15	1.15	1.20	1.29	1.33	1.39	1.49	1.55	1.66	1.71	1.79
1.93	2.00	2.15	2.25	2.37	2.56	2.72	2.90	3.13	3.32	3.53
3.72	3.94	4.19	4.42	4.66	4.94	5.20	5.50	5.77	6.06	6.41
6.73	7.09	7.42	7.80	8.20	8.58	9.01	9.46	9.90	10.40	10.88
11.40	11.95	12.49	13.07	13.70	14.34	15.02	15.71	16.44	17.23	18.02
18.88	19.73	20.66	21.64	22.63	23.65	24.66	25.62	26.51	27.28	27.93
28.46	28.88	29.22	29.50	29.70	29.85	29.96	30.04	30.09	30.12	30.15
30.15	30.16	30.17	30.18	30.18	30.19	30.19	30.19	30.19	30.18	30.18

AUTOCAP LOT P. RAD FIRING NO. 3

1.05	1.10	1.19	1.22	1.32	1.40	1.44	1.54	1.59	1.67	1.79
1.88	2.08	2.11	2.22	2.45	2.55	2.72	2.94	3.10	3.34	3.52
3.74	3.99	4.19	4.46	4.67	4.92	5.22	5.48	5.76	6.09	6.37
6.72	7.03	7.38	7.78	8.14	8.54	8.98	9.40	9.87	10.32	10.81
11.34	11.85	12.43	13.00	13.60	14.27	14.89	15.60	16.36	17.09	17.92
18.76	19.64	20.61	21.54	22.55	23.56	24.56	25.52	26.41	27.19	27.82
28.36	28.77	29.12	29.38	29.57	29.73	29.84	29.92	29.97	29.99	30.02
30.04	30.04	30.05	30.05	30.05	30.05	30.05	30.05	30.05	30.05	30.04

AUTOCAP LOT P. RAD FIRING NO. 4

1.13	1.21	1.24	1.30	1.40	1.45	1.55	1.60	1.67	1.79	1.86
1.95	2.07	2.15	2.29	2.38	2.51	2.69	2.82	3.03	3.21	3.41
3.66	3.86	4.09	4.36	4.61	4.88	5.13	5.38	5.71	6.02	6.34
6.71	7.05	7.45	7.80	8.20	8.64	9.03	9.49	9.93	10.40	10.94
11.45	11.99	12.57	13.14	13.77	14.39	15.07	15.79	16.51	17.30	18.12
18.95	19.85	20.77	21.73	22.73	23.73	24.75	25.71	26.59	27.36	28.00
28.56	28.97	29.31	29.56	29.79	29.93	30.03	30.10	30.15	30.18	30.21
30.22	30.23	30.24	30.25	30.25	30.25	30.25	30.25	30.25	30.25	30.25

AUTOCAP LOT P. RAD FIRING NO. 5

1.15	1.22	1.25	1.31	1.40	1.46	1.57	1.63	1.73	1.83	1.90
1.99	2.12	2.21	2.35	2.46	2.59	2.78	2.94	3.13	3.35	3.54
3.78	3.98	4.22	4.49	4.72	5.01	5.27	5.55	5.86	6.16	6.49
6.84	7.17	7.56	7.93	8.31	8.74	9.16	9.60	10.08	10.54	11.06
11.56	12.09	12.69	13.27	13.87	14.52	15.19	15.92	16.65	17.42	18.27
19.11	20.02	20.93	21.90	22.91	23.92	24.90	25.86	26.68	27.40	27.98
28.46	28.84	29.14	29.38	29.55	29.69	29.78	29.84	29.88	29.91	29.92
29.94	29.95	29.96	29.95	29.96	29.95	29.97	29.96	29.96	29.95	29.93

AUTOCAP LOT P. RAD FIRING NO. 6

1.08	1.16	1.19	1.24	1.34	1.38	1.45	1.57	1.63	1.74	1.80
1.90	2.06	2.14	2.25	2.41	2.52	2.71	2.87	3.04	3.28	3.47
3.70	3.90	4.13	4.40	4.61	4.86	5.17	5.42	5.74	6.01	6.33
6.68	6.99	7.34	7.72	8.11	8.52	8.92	9.35	9.82	10.28	10.79
11.28	11.82	12.41	12.99	13.59	14.24	14.91	15.62	16.34	17.11	18.02
18.80	19.68	20.62	21.59	22.61	23.65	24.71	25.74	26.69	27.53	28.24
28.81	29.28	29.66	29.95	30.17	30.34	30.46	30.55	30.61	30.64	30.66
30.67	30.69	30.70	30.70	30.70	30.71	30.71	30.71	30.71	30.71	30.70

AUTOCAP LOT Q. RAD FIRING NO. 1

1.54	1.57	1.65	1.75	1.82	1.93	2.01	2.11	2.26	2.35	2.49
2.66	2.79	3.00	3.16	3.34	3.58	3.77	4.00	4.19	4.40	4.67
4.88	5.12	5.41	5.66	5.95	6.20	6.49	6.83	7.12	7.48	7.77
8.11	8.49	8.82	9.18	9.59	9.97	10.41	10.82	11.25	11.74	12.20
12.69	13.23	13.75	14.33	14.90	15.51	16.15	16.80	17.47	18.24	19.00
19.82	20.63	21.48	22.38	23.28	24.19	25.08	25.91	26.65	27.29	27.84
28.30	28.67	28.98	29.24	29.44	29.60	29.72	29.81	29.88	29.92	29.96
29.98	29.99	30.01	30.01	30.02	30.02	30.03	30.03	30.03	30.03	30.02

AUTOCAP LOT Q. RAD FIRING NO. 2

1.54	1.60	1.71	1.76	1.87	1.95	2.04	2.17	2.26	2.37	2.52
2.65	2.82	2.96	3.14	3.37	3.54	3.74	3.97	4.16	4.42	4.62
4.86	5.14	5.38	5.67	5.92	6.21	6.53	6.81	7.11	7.46	7.77
8.14	8.48	8.86	9.22	9.58	9.97	10.40	10.81	11.27	11.71	12.18
12.70	13.19	13.74	14.27	14.84	15.46	16.07	16.73	17.42	18.13	18.89
19.65	20.46	21.32	22.19	23.10	23.99	24.86	25.70	26.45	27.12	27.69
28.17	28.56	28.89	29.16	29.37	29.53	29.67	29.77	29.84	29.89	29.93
29.96	29.97	29.99	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00

AUTOCAP LOT Q. RAD FIRING NO. 3

1.34	1.43	1.48	1.59	1.65	1.74	1.87	1.95	2.05	2.20	2.31
2.48	2.63	2.82	3.03	3.20	3.43	3.60	3.82	4.07	4.26	4.49
4.76	4.98	5.27	5.52	5.79	6.09	6.36	6.66	7.00	7.30	7.65
7.97	8.27	8.71	9.07	9.49	9.87	10.30	10.75	11.18	11.64	12.15
12.66	13.21	13.74	14.31	14.92	15.53	16.17	16.87	17.57	18.32	19.08
19.89	20.75	21.62	22.53	23.46	24.38	25.29	26.12	26.86	27.49	28.03
28.49	28.86	29.16	29.41	29.60	29.77	29.88	29.96	30.02	30.11	30.09
30.10	30.11	30.12	30.13	30.14	30.14	30.14	30.14	30.14	30.13	30.13

AUTOCAP LOT Q. RAD FIRING NO. 4

1.49	1.58	1.62	1.69	1.80	1.87	1.98	2.05	2.15	2.28	2.37
2.52	2.63	2.78	2.98	3.15	3.34	3.57	3.76	4.00	4.19	4.41
4.67	4.90	5.15	5.43	5.68	5.99	6.26	6.54	6.88	7.17	7.53
7.85	8.19	8.57	8.92	9.29	9.71	10.06	10.52	10.94	11.40	11.88
12.34	12.87	13.40	13.92	14.51	15.08	15.70	16.37	17.03	17.75	18.47
19.24	20.06	20.88	21.75	22.65	23.56	24.49	25.37	26.20	26.95	27.60
28.15	28.61	28.99	29.30	29.55	29.75	29.92	30.05	30.12	30.18	30.22
30.24	30.27	30.29	30.30	30.31	30.31	30.31	30.31	30.31	30.31	30.31

AUTOCAP LOT Q. RAD FIRING NO. 5

1.51	1.56	1.66	1.76	1.84	1.89	1.93	2.10	2.19	2.30	2.45
2.55	2.75	2.88	3.05	3.27	3.44	3.67	3.87	4.09	4.33	4.53
4.78	5.05	5.29	5.60	5.84	6.14	6.47	6.76	7.07	7.41	7.72
8.09	8.42	8.78	9.17	9.53	9.95	10.34	10.77	11.23	11.69	12.16
12.64	13.17	13.74	14.29	14.87	15.51	16.14	16.80	17.52	18.24	19.02
19.81	20.64	21.52	22.41	23.34	24.26	25.17	26.02	26.78	27.45	28.01
28.49	28.88	29.20	29.45	29.65	29.82	29.94	30.03	30.10	30.14	30.17
30.19	30.21	30.22	30.23	30.23	30.23	30.23	30.23	30.23	30.23	30.23

AUTOCAP LOT Q. RAD FIRING NO. 6

1.59	1.68	1.73	1.84	1.90	1.98	2.10	2.18	2.28	2.42	2.52
2.69	2.83	3.01	3.22	3.40	3.62	3.81	4.02	4.27	4.48	4.71
4.99	5.23	5.53	5.78	6.05	6.37	6.65	6.95	7.29	7.60	7.95
8.28	8.64	9.03	9.39	9.79	10.19	10.60	11.05	11.48	11.94	12.44
12.93	13.47	13.99	14.54	15.15	15.76	16.42	17.09	17.77	18.52	19.27
20.07	20.92	21.78	22.68	23.58	24.49	25.37	26.18	26.91	27.55	28.09
28.52	28.89	29.18	29.44	29.60	29.78	29.90	29.99	30.04	30.09	30.11
30.13	30.14	30.15	30.16	30.17	30.17	30.17	30.17	30.17	30.17	30.16

AUTOCAP LOT R. RAD FIRING NO. 1

.42	.45	.50	.51	.53	.59	.60	.67	.68	.71	.78
.81	.88	.91	.95	1.05	1.10	1.16	1.26	1.32	1.43	1.50
1.59	1.73	1.81	1.93	2.09	2.20	2.37	2.50	2.67	2.90	3.07
3.36	3.63	3.95	4.31	4.64	5.01	5.44	5.84	6.31	6.75	7.25
7.80	8.33	8.89	9.53	10.17	10.87	11.59	12.36	13.20	14.06	15.02
16.01	17.07	18.22	19.40	20.68	22.06	23.46	24.90	26.24	27.42	28.40
29.16	29.76	30.17	30.49	30.70	30.87	30.96	31.00	31.03	31.06	31.08
31.10	31.12	31.12	31.13	31.13	31.14	31.14	31.15	31.14	31.14	31.14

AUTOCAP LOT R. RAD FIRING NO. 2

.32	.34	.40	.40	.43	.50	.52	.57	.57	.59	.67
.69	.78	.80	.85	.95	.98	1.05	1.16	1.21	1.33	1.39
1.49	1.62	1.71	1.83	1.99	2.11	2.29	2.43	2.61	2.84	3.03
3.32	3.59	3.91	4.27	4.61	4.98	5.41	5.82	6.28	6.73	7.23
7.78	8.31	8.87	9.51	10.13	10.85	11.57	12.35	13.16	14.05	15.00
15.99	17.07	18.23	19.43	20.72	22.09	23.49	24.92	26.27	27.47	28.46
29.23	29.82	30.25	30.56	30.78	30.92	31.01	31.07	31.11	31.14	31.15
31.17	31.18	31.19	31.19	31.20	31.20	31.20	31.21	31.21	31.21	31.20

AUTOCAP LOT R. RAD FIRING NO. 3

.47	.52	.52	.58	.58	.61	.68	.69	.72	.79	.80
.87	.90	.94	1.02	1.07	1.15	1.21	1.26	1.37	1.44	1.52
1.64	1.73	1.87	1.96	2.08	2.25	2.37	2.52	2.72	2.89	3.12
3.34	3.63	3.97	4.27	4.66	5.06	5.44	5.86	6.28	6.75	7.29
7.81	8.38	8.94	9.56	10.25	10.93	11.65	12.45	13.26	14.17	15.11
16.12	17.21	18.34	19.57	20.86	22.23	23.67	25.11	26.46	27.67	28.66
29.43	30.02	30.45	30.76	30.97	31.11	31.20	31.25	31.29	31.29	31.34
31.35	31.37	31.37	31.40	31.39	31.39	31.40	31.40	31.40	31.40	31.39

AUTOCAP LOT R. RAD FIRING NO. 4

0.00	0.00	0.00	2.01	.85	.58	.50	.51	.56	.59	.66
.68	.73	.81	.84	.92	.97	1.03	1.14	1.20	1.31	1.41
1.48	1.61	1.70	1.81	1.98	2.09	2.23	2.42	2.57	2.80	2.99
3.25	3.57	3.87	4.23	4.56	4.93	5.35	5.74	6.18	6.66	7.13
7.68	8.19	8.75	9.37	9.97	10.65	11.40	12.15	12.98	13.84	14.76
15.76	16.79	17.94	19.12	20.39	21.76	23.17	24.62	26.00	27.25	28.29
29.11	29.72	30.18	30.52	30.75	30.91	31.00	31.07	31.11	31.14	31.16
31.17	31.18	31.19	31.20	31.20	31.22	31.20	31.21	31.22	31.20	31.21

AUTOCAP LOT R. RAD FIRING NO. 5

.42	.42	.43	.49	.48	.51	.58	.59	.65	.69	.71
.78	.80	.87	.91	.96	1.06	1.10	1.18	1.29	1.35	1.47
1.54	1.64	1.80	1.96	2.03	2.19	2.31	2.51	2.66	2.85	3.12
3.36	3.69	3.99	4.32	4.71	5.07	5.46	5.90	6.32	6.81	7.28
7.80	8.37	8.93	9.53	10.21	10.88	11.62	12.37	13.18	14.08	14.99
16.00	17.05	18.18	19.40	20.67	22.03	23.42	24.86	26.21	27.38	28.34
29.10	29.68	30.10	30.41	30.62	30.76	30.85	30.91	30.95	30.98	30.99
31.01	31.03	31.06	30.99	31.04	31.06	31.06	31.06	31.07	31.06	31.06

AUTOCAP LOT R. RAD FIRING NO. 6

.42	.41	.45	.45	.47	.54	.54	.59	.62	.65	.72
.79	.81	.88	.91	.96	1.05	1.10	1.20	1.26	1.34	1.46
1.53	1.66	1.76	1.87	2.03	2.15	2.29	2.48	2.63	2.85	3.05
3.31	3.64	3.95	4.29	4.67	5.03	5.46	5.87	6.32	6.82	7.30
7.87	8.43	9.02	9.67	10.32	11.02	11.78	12.58	13.45	14.34	15.31
16.35	17.44	18.60	19.88	21.18	22.60	24.04	25.46	26.78	27.90	28.79
29.49	30.01	30.39	30.66	30.84	30.95	31.03	31.08	31.11	31.14	31.15
31.17	31.17	31.18	31.19	31.20	31.21	31.21	31.20	31.21	31.20	31.22

AUTOCAP LOT S. RAD FIRING NO. 1

.57	.57	.59	.66	.67	.74	.76	.79	.88	.90	.98
1.02	1.08	1.17	1.22	1.29	1.41	1.47	1.58	1.66	1.76	1.91
2.00	2.13	2.28	2.38	2.62	2.78	2.99	3.25	3.50	3.82	4.11
4.43	4.80	5.14	5.51	5.94	6.33	6.78	7.21	7.68	8.19	8.68
9.21	9.79	10.37	11.02	11.66	12.36	13.12	13.89	14.73	15.60	16.51
17.49	18.50	19.56	20.68	21.81	22.97	24.11	25.21	26.22	27.12	27.85
28.44	28.91	29.28	29.55	29.75	29.87	30.00	30.07	30.13	30.17	30.19
30.21	30.22	30.23	30.24	30.25	30.25	30.26	30.26	30.26	30.26	30.26

AUTOCAP LOT S. RAD FIRING NO. 2

.57	.59	.66	.67	.71	.78	.79	.86	.89	.93	1.02
1.05	1.15	1.19	1.27	1.37	1.43	1.52	1.64	1.70	1.85	1.95
2.07	2.23	2.35	2.53	2.70	2.86	3.09	3.31	3.57	3.89	4.19
4.55	4.87	5.22	5.64	6.02	6.45	6.90	7.32	7.81	8.28	8.79
9.40	9.92	10.53	11.13	11.79	12.52	13.24	14.03	14.88	15.74	16.67
17.64	18.67	19.75	20.85	22.00	23.17	24.32	25.43	26.44	27.33	28.08
28.69	29.16	29.52	29.79	30.00	30.15	30.26	30.33	30.39	30.42	30.45
30.47	30.49	30.50	30.49	30.51	30.52	30.52	30.52	30.52	30.51	30.51

AUTOCAP LOT S. RAD FIRING NO. 3

.55	.54	.56	.63	.65	.68	.76	.78	.86	.89	.93
1.03	1.07	1.14	1.24	1.30	1.41	1.47	1.56	1.69	1.79	1.93
2.04	2.17	2.35	2.49	2.67	2.88	3.08	3.34	3.59	3.88	4.22
4.52	4.90	5.27	5.64	6.05	6.46	6.85	7.36	7.83	8.35	8.83
9.39	10.00	10.60	11.25	11.95	12.67	13.44	14.24	15.09	16.01	16.96
17.98	19.02	20.11	21.25	22.40	23.57	24.71	25.79	26.77	27.60	28.30
28.86	29.29	29.62	29.87	30.05	30.19	30.28	30.35	30.39	30.43	30.46
30.48	30.48	30.48	30.50	30.52	30.50	30.52	30.48	30.53	30.52	30.52

AUTOCAP LOT S. RAD FIRING NO. 4

.59	.67	.67	.67	.67	.75	.77	.82	.89	.92	1.00
1.03	1.09	1.19	1.24	1.34	1.40	1.48	1.60	1.68	1.80	1.94
2.03	2.19	2.31	2.46	2.66	2.83	3.05	3.27	3.53	3.85	4.12
4.45	4.82	5.15	5.55	5.90	6.30	6.75	7.16	7.64	8.14	8.63
9.17	9.72	10.30	10.95	11.58	12.29	13.00	13.77	14.62	15.47	16.37
17.35	18.34	19.42	20.55	21.67	22.85	24.02	25.17	26.22	27.16	27.95
28.59	29.10	29.48	29.78	30.00	30.15	30.27	30.34	30.40	30.44	30.46
30.48	30.49	30.50	30.51	30.54	30.54	30.54	30.51	30.54	30.53	30.54

AUTOCAP LOT S. RAD FIRING NO. 5

.66	.66	.69	.76	.76	.84	.87	.91	1.01	1.04	1.10
1.20	1.24	1.34	1.40	1.47	1.60	1.67	1.76	1.90	2.00	2.14
2.25	2.38	2.56	2.71	2.91	3.09	3.31	3.60	3.86	4.16	4.51
4.84	5.20	5.57	5.94	6.37	6.77	7.20	7.69	8.14	8.66	9.14
9.69	10.28	10.86	11.51	12.16	12.85	13.62	14.40	15.23	16.13	17.04
18.04	19.05	20.12	21.23	22.35	23.47	24.61	25.64	26.58	27.37	28.02
28.55	28.95	29.27	29.49	29.66	29.79	29.87	29.94	29.98	30.02	30.03
30.05	30.04	30.06	30.09	30.10	30.09	30.10	30.09	30.09	30.09	30.09

AUTOCAP LOT S. RAD FIRING NO. 6

.52	.56	.59	.61	.66	.70	.73	.81	.83	.91	.94
1.00	1.09	1.14	1.20	1.31	1.37	1.48	1.55	1.65	1.79	1.85
2.03	2.13	2.26	2.44	2.59	2.77	3.02	3.24	3.54	3.81	4.13
4.49	4.81	5.19	5.60	5.99	6.42	6.84	7.29	7.79	8.27	8.81
9.35	9.92	10.5	11.17	11.84	12.58	13.33	14.15	14.98	15.88	16.85
17.83	18.88	19.99	21.12	22.30	23.48	24.65	25.78	26.79	27.65	28.36
28.94	29.38	29.71	29.96	30.15	30.28	30.38	30.44	30.49	30.52	30.54
30.55	30.58	30.58	30.60	30.60	30.61	30.61	30.61	30.60	30.61	30.61

AUTOCAP LOT T. RAD FIRING NO. 1

1.23	1.24	1.33	1.38	1.44	1.55	1.61	1.72	1.79	1.89	2.02
2.12	2.24	2.41	2.55	2.76	2.93	3.13	3.38	3.59	3.83	4.04
4.26	4.54	4.75	4.92	5.30	5.57	5.89	6.17	6.47	6.83	7.13
7.47	7.85	8.19	8.59	8.97	9.37	9.82	10.23	10.72	11.17	11.66
12.20	12.72	13.28	13.88	14.48	15.13	15.79	16.48	17.21	17.96	18.75
19.59	20.45	21.35	22.26	23.18	24.10	24.98	25.70	26.41	26.99	27.46
27.85	28.15	28.40	28.60	28.74	28.84	28.93	28.98	29.02	29.04	29.05
29.06	29.07	29.08	29.07	29.07	29.08	29.07	29.07	29.07	29.07	29.06

AUTOCAP LOT T. RAD FIRING NO. 2

1.24	1.29	1.39	1.43	1.53	1.58	1.66	1.77	1.85	1.97	2.05
2.15	2.30	2.41	2.59	2.77	2.95	3.16	3.35	3.55	3.79	4.00
4.24	4.50	4.75	5.01	5.27	5.53	5.85	6.15	6.47	6.73	7.09
7.46	7.79	8.16	8.55	8.93	9.35	9.75	10.19	10.66	11.13	11.62
12.15	12.67	13.25	13.81	14.43	15.08	15.74	16.45	17.17	17.94	18.77
19.55	20.48	21.41	22.34	23.33	24.27	25.17	26.01	26.71	27.31	27.82
28.23	28.56	28.81	29.01	29.18	29.29	29.37	29.42	29.46	29.48	29.50
29.51	29.52	29.51	29.52	29.51	29.51	29.52	29.52	29.51	29.50	29.50

AUTOCAP LOT T. RAD FIRING NO. 3

1.14	1.18	1.28	1.33	1.40	1.50	1.56	1.68	1.74	1.83	1.97
2.06	2.21	2.32	2.46	2.68	2.85	3.04	3.28	3.47	3.71	3.91
4.14	4.42	4.64	4.93	5.17	5.44	5.76	6.03	6.33	6.67	6.97
7.34	7.67	8.02	8.42	8.78	9.19	9.64	10.05	10.52	10.96	11.47
12.00	12.53	13.10	13.66	14.28	14.94	15.59	16.30	17.04	17.79	18.60
19.45	20.33	21.26	22.20	23.18	24.16	25.04	25.86	26.58	27.19	27.69
28.10	28.43	28.69	28.90	29.05	29.17	29.25	29.30	29.34	29.36	29.37
29.38	29.39	29.40	29.40	29.40	29.40	29.40	29.39	29.39	29.39	29.39

AUTOCAP LOT T. RAD FIRING NO. 4

1.08	1.16	1.20	1.30	1.34	1.40	1.53	1.60	1.71	1.82	1.89
2.03	2.13	2.25	2.43	2.58	2.79	2.97	3.18	3.44	3.63	3.85
4.12	4.33	4.60	4.85	5.11	5.41	5.68	6.00	6.32	6.64	6.98
7.31	7.68	8.06	8.43	8.84	9.23	9.66	10.13	10.58	11.08	11.60
12.11	12.67	13.24	13.84	14.48	15.12	15.81	16.52	17.26	18.05	18.85
19.71	20.61	21.52	22.48	23.44	24.38	25.27	26.07	26.77	27.34	27.81
28.19	28.49	28.73	28.92	29.04	29.14	29.23	29.28	29.30	29.29	29.31
29.33	29.33	29.34	29.34	29.34	29.34	29.34	29.33	29.34	29.33	29.31

AUTOCAP LOT T. RAD FIRING NO. 5

1.30	1.35	1.45	1.50	1.60	1.65	1.73	1.86	1.92	2.05	2.16
2.25	2.40	2.47	2.65	2.87	3.04	3.27	3.44	3.66	3.91	4.11
4.34	4.62	4.85	5.14	5.39	5.67	5.98	6.25	6.61	6.89	7.21
7.58	7.93	8.29	8.69	9.07	9.50	9.89	10.32	10.82	11.27	11.76
12.30	12.83	13.42	13.98	14.60	15.28	15.93	16.65	17.37	18.15	18.99
19.82	20.71	21.66	22.59	23.55	24.48	25.35	26.14	26.81	27.37	27.84
28.22	28.52	28.71	28.92	29.06	29.17	29.24	29.28	29.31	29.32	29.34
29.34	29.35	29.35	29.35	29.35	29.35	29.35	29.34	29.34	29.34	29.33

AUTOCAP LOT T. RAD FIRING NO. 6

1.10	1.13	1.18	1.28	1.32	1.40	1.51	1.57	1.68	1.71	1.84
1.97	2.06	2.20	2.38	2.42	2.59	2.74	2.91	3.14	3.34	3.58
3.80	4.02	4.29	4.53	4.79	5.09	5.35	5.66	5.95	6.27	6.64
6.95	7.31	7.66	8.04	8.47	8.83	9.24	9.71	10.15	10.63	11.10
11.61	12.17	12.71	13.32	13.94	14.55	15.23	15.91	16.64	17.42	18.21
19.07	19.94	20.86	21.84	22.81	23.81	24.77	25.67	26.47	27.16	27.74
28.21	28.58	28.88	29.11	29.29	29.42	29.51	29.58	29.60	29.64	29.67
29.68	29.69	29.69	29.67	29.72	29.71	29.70	29.70	29.71	29.69	29.69

AUTOCAP LOT U. RAD FIRING NO. 1

1.98	2.09	2.19	2.28	2.43	2.55	2.72	2.92	3.08	3.29	3.48
3.68	3.91	4.10	4.31	4.56	4.77	5.03	5.24	5.47	5.75	5.97
6.24	6.50	6.76	7.06	7.32	7.63	7.92	8.18	8.50	8.80	9.13
9.47	9.80	10.15	10.54	10.91	11.31	11.71	12.12	12.58	13.01	13.50
13.98	14.47	15.02	15.56	16.13	16.66	17.34	18.02	18.70	19.41	20.15
20.91	21.70	22.52	23.30	24.07	24.77	25.40	25.96	26.43	26.84	27.15
27.40	27.65	27.81	27.96	28.09	28.18	28.25	28.29	28.31	28.35	28.36
28.36	28.37	28.37	28.37	28.37	28.37	28.37	28.36	28.36	28.35	28.34

AUTOCAP LOT U. RAD FIRING NO. 2

2.13	2.17	2.30	2.37	2.46	2.64	2.75	2.89	3.08	3.22	3.44
3.60	3.80	4.04	4.24	4.46	4.72	4.94	5.20	5.42	5.67	5.96
6.19	6.48	6.73	6.99	7.30	7.58	7.87	8.19	8.46	8.80	9.11
9.44	9.80	10.13	10.49	10.89	11.27	11.60	12.07	12.51	12.98	13.44
13.98	14.44	14.96	15.53	16.08	16.68	17.32	17.96	18.65	19.35	20.09
20.87	21.65	22.45	23.28	24.07	24.84	25.52	26.13	26.65	27.10	27.47
27.78	28.04	28.25	28.42	28.55	28.65	28.73	28.78	28.82	28.84	28.86
28.87	28.88	28.88	28.85	28.88	28.89	28.88	28.85	28.87	28.87	28.87

AUTOCAP LOT U. RAD FIRING NO. 3

1.91	2.01	2.08	2.18	2.33	2.42	2.56	2.75	2.88	3.08	3.28
3.48	3.72	3.90	4.14	4.37	4.57	4.82	5.04	5.28	5.56	5.79
6.08	6.32	6.58	6.88	7.13	7.41	7.72	8.00	8.32	8.61	8.92
9.28	9.60	9.96	10.31	10.68	11.10	11.48	11.91	12.35	12.78	13.26
13.72	14.23	14.77	15.30	15.87	16.47	17.12	17.75	18.41	19.19	19.86
20.61	21.41	22.22	23.04	23.85	24.61	25.32	25.95	26.48	26.95	27.33
27.62	27.91	28.13	28.31	28.44	28.55	28.63	28.68	28.72	28.74	28.76
28.76	28.78	28.78	28.78	28.78	28.78	28.78	28.78	28.78	28.77	28.76

AUTOCAP LOT U. RAD FIRING NO. 4

1.84	1.92	2.05	2.09	2.22	2.32	2.45	2.63	2.77	2.98	3.15
3.33	3.56	3.75	3.94	4.20	4.40	4.65	4.87	5.10	5.37	5.59
5.83	6.12	6.36	6.66	6.91	7.18	7.49	7.76	8.08	8.37	8.68
9.02	9.34	9.68	10.06	10.41	10.81	11.20	11.60	12.04	12.46	12.92
13.37	13.88	14.42	14.93	15.49	16.09	16.68	17.32	17.97	18.66	19.38
20.11	20.90	21.72	22.54	23.37	24.17	24.94	25.65	26.26	26.77	27.21
27.58	27.90	28.14	28.34	28.51	28.63	28.73	28.80	28.85	28.88	28.90
28.92	28.93	28.92	28.93	28.94	28.94	28.95	28.94	28.94	28.93	28.93

AUTOCAP LOT U. RAD FIRING NO. 5

1.97	2.01	2.10	2.23	2.33	2.45	2.63	2.77	2.97	3.13	3.33
3.56	3.74	3.97	4.16	4.38	4.63	4.84	5.07	5.34	5.57	5.84
6.07	6.32	6.62	6.86	7.15	7.45	7.72	8.04	8.32	8.62	8.97
9.27	9.66	10.00	10.36	10.76	11.14	11.54	11.98	12.41	12.87	13.33
13.82	14.35	14.86	15.43	16.01	16.58	17.22	17.86	18.53	19.25	19.98
20.76	21.53	22.33	23.15	23.93	24.66	25.34	25.92	26.42	26.85	27.20
27.50	27.74	27.94	28.10	28.23	28.33	28.40	28.44	28.45	28.49	28.52
28.55	28.55	28.54	28.54	28.54	28.53	28.53	28.54	28.53	28.53	28.53

AUTOCAP LOT U. RAD FIRING NO. 6

1.87	1.96	2.05	2.16	2.24	2.35	2.50	2.65	2.78	2.97	3.13
3.34	3.52	3.73	3.97	4.17	4.43	4.64	4.88	5.15	5.39	5.63
5.91	6.18	6.47	6.72	6.99	7.30	7.57	7.86	8.20	8.47	8.81
9.12	9.46	9.83	10.17	10.56	10.93	11.33	11.76	12.17	12.61	13.09
13.56	14.09	14.58	15.13	15.70	16.28	16.89	17.57	18.16	18.91	19.64
20.40	21.21	22.02	22.87	23.69	24.50	25.26	25.94	26.53	27.04	27.46
27.82	28.11	28.35	28.54	28.69	28.82	28.91	28.97	29.02	29.04	29.06
29.08	29.09	29.10	29.10	29.09	29.09	29.09	29.08	29.09	29.09	29.08

AUTOCAP LOT V. RAD FIRING NO. 1

.38	.41	.46	.47	.53	.54	.57	.63	.66	.69	.76
.78	.87	.91	.94	1.05	1.10	1.17	1.28	1.34	1.46	1.53
1.63	1.78	1.88	2.03	2.15	2.29	2.49	2.65	2.86	3.13	3.39
3.73	4.03	4.38	4.77	5.13	5.54	6.01	6.43	6.92	7.38	7.89
8.46	9.00	9.63	10.22	10.88	11.60	12.31	13.09	13.95	14.80	15.76
16.75	17.81	18.96	20.15	21.41	22.72	24.06	25.31	26.37	27.25	27.96
28.50	28.92	29.21	29.43	29.59	29.68	29.76	29.79	29.82	29.84	29.85
29.86	29.86	29.87	29.88	29.88	29.89	29.89	29.90	29.90	29.89	29.89

AUTOCAP LOT V. RAD FIRING NO. 2

.34	.39	.39	.45	.45	.47	.54	.55	.58	.65	.66
.7[illegible]	.77	.82	.90	.93	1.00	1.10	1.15	1.26	1.32	1.41
1.55	1.63	1.77	1.87	2.01	2.17	2.24	2.47	2.71	2.86	3.20
3.50	3.81	4.18	4.53	4.93	5.33	5.73	6.19	6.64	7.12	7.66
8.17	8.76	9.33	9.94	10.62	11.32	12.03	12.82	13.65	14.54	15.47
16.46	17.55	18.67	19.90	21.17	22.51	23.89	25.18	26.34	27.36	28.11
28.71	29.17	29.51	29.76	29.93	30.04	30.12	30.15	30.19	30.21	30.23
30.25	30.26	30.27	30.27	30.28	30.29	30.28	30.28	30.28	30.28	30.28

AUTOCAP LOT V. RAD FIRING NO. 3

.43	.43	.43	.47	.49	.55	.56	.59	.66	.68	.75
.78	.82	.90	.93	.99	1.09	1.13	1.24	1.30	1.38	1.51
1.58	1.68	1.84	1.94	2.10	2.22	2.37	2.57	2.73	2.96	3.19
3.47	3.82	4.15	4.51	4.93	5.32	5.80	6.23	6.70	7.25	7.75
8.31	8.89	9.50	10.15	10.79	11.50	12.27	13.04	13.89	14.76	15.71
16.72	17.78	18.91	20.13	21.38	22.70	24.01	25.25	26.35	27.25	27.99
28.54	28.97	29.29	29.53	29.68	29.79	29.86	29.91	29.94	29.96	29.98
29.99	29.99	30.01	30.02	30.03	30.05	30.04	30.04	30.05	30.03	30.03

AUTOCAP LOT V. RAD FIRING NO. 4

.42	.42	.45	.49	.48	.55	.56	.56	.66	.67	.71
.79	.81	.89	.92	.98	1.08	1.12	1.23	1.29	1.37	1.49
1.57	1.67	1.83	1.93	2.10	2.23	2.39	2.61	2.81	3.06	3.39
3.69	4.04	4.37	4.74	5.15	5.54	5.99	6.42	6.87	7.39	7.89
8.45	9.03	9.63	10.28	10.95	11.76	12.45	13.22	14.07	14.98	15.93
16.97	18.06	19.23	20.48	21.78	23.15	24.49	25.73	26.80	27.66	28.35
28.87	29.27	29.56	29.77	29.91	29.99	30.05	30.09	30.11	30.12	30.14
30.14	30.15	30.16	30.17	30.18	30.17	30.18	30.18	30.17	30.17	30.16

AUTOCAP LOT V. RAD FIRING NO. 5

0.00	0.00	0.00	2.06	.87	.63	.56	.57	.63	.64	.71
.72	.77	.84	.87	.95	.99	1.06	1.17	1.22	1.30	1.44
1.51	1.65	1.75	1.87	2.06	2.18	2.35	2.55	2.75	3.02	3.28
3.59	3.95	4.28	4.68	5.04	5.44	5.89	6.32	6.79	7.32	7.84
8.37	8.91	9.50	10.16	10.80	11.51	12.28	13.06	13.92	14.80	15.74
16.78	17.86	19.03	20.25	21.56	22.92	24.29	25.58	26.72	27.65	28.39
28.97	29.38	29.72	29.95	30.08	30.20	30.30	30.31	30.31	30.35	30.36
30.37	30.38	30.38	30.39	30.40	30.40	30.41	30.41	30.41	30.41	30.41

AUTOCAP LOT V. RAD FIRING NO. 6

0.00	0.00	0.00	0.00	0.00	2.07	.87	.64	.57	.62	.67
.68	.75	.77	.83	.91	.96	1.06	1.11	1.20	1.32	1.40
1.50	1.63	1.75	1.91	2.02	2.16	2.35	2.54	2.77	2.98	3.25
3.58	3.89	4.24	4.63	5.00	5.43	5.83	6.28	6.77	7.25	7.77
8.32	8.97	9.68	10.08	10.73	11.45	12.16	12.97	13.79	14.66	15.62
16.61	17.68	18.84	20.04	21.34	22.68	24.04	25.36	26.52	27.52	28.29
28.90	29.34	29.67	29.92	30.10	30.20	30.27	30.32	30.35	30.38	30.40
30.40	30.42	30.42	30.42	30.43	30.44	30.44	30.43	30.44	30.44	30.43

AUTOCAP LOT W. RAD FIRING NO. 1

.49	.56	.57	.64	.69	.71	.79	.82	.87	.96	1.01
1.11	1.18	1.23	1.35	1.41	1.50	1.64	1.72	1.86	1.96	2.08
2.25	2.37	2.57	2.72	2.91	3.17	3.41	3.70	4.04	4.33	4.69
5.01	5.36	5.78	6.13	6.53	6.97	7.38	7.85	8.29	8.75	9.28
9.77	10.33	10.87	11.46	12.10	12.75	13.42	14.18	14.94	15.77	16.62
17.54	18.52	19.54	20.64	21.79	22.96	24.12	25.20	26.15	26.95	27.61
28.13	28.54	28.86	29.10	29.28	29.40	29.49	29.54	29.58	29.61	29.64
29.63	29.64	29.59	29.64	29.66	29.66	29.67	29.67	29.67	29.67	29.66

AUTOCAP LOT W. RAD FIRING NO. 2

.61	.61	.63	.70	.72	.78	.81	.85	.93	.97	1.02
1.12	1.17	1.27	1.33	1.40	1.54	1.62	1.72	1.86	1.96	2.12
2.23	2.36	2.55	2.68	2.92	3.10	3.33	3.64	3.92	4.23	4.58
4.92	5.31	5.67	6.06	6.51	6.90	7.35	7.84	8.28	8.79	9.27
9.77	10.36	10.90	11.52	12.13	12.79	13.51	14.24	15.02	15.87	16.74
17.69	18.66	19.70	20.82	21.97	23.15	24.31	25.39	26.32	27.10	27.74
28.23	28.64	28.96	29.19	29.35	29.47	29.55	29.68	29.64	29.66	29.67
29.69	29.70	29.70	29.71	29.72	29.72	29.72	29.72	29.72	29.72	29.71

AUTOCAP LOT W. RAD FIRING NO. 3

.76	.76	.82	.83	.87	.94	.97	1.05	1.12	1.14	1.23
1.28	1.35	1.46	1.52	1.64	1.71	1.81	1.95	2.04	2.16	2.33
2.44	2.62	2.75	2.92	3.16	3.33	3.65	3.92	4.24	4.60	4.92
5.27	5.68	6.04	6.47	6.87	7.30	7.77	8.21	8.67	9.19	9.69
10.24	10.77	11.34	11.98	12.61	13.30	14.00	14.75	15.56	16.38	17.28
18.24	19.22	20.29	21.40	22.54	23.70	24.80	25.79	26.63	27.32	27.92
28.35	28.69	28.99	29.17	29.30	29.40	29.44	29.50	29.54	29.56	29.57
29.59	29.59	29.60	29.61	29.62	29.61	29.62	29.62	29.61	29.61	29.62

AUTOCAP LOT W. RAD FIRING NO. 4

.65	.64	.70	.71	.75	.83	.85	.93	.99	1.02	1.11
1.15	1.21	1.31	1.37	1.49	1.56	1.65	1.79	1.88	2.00	2.15
2.27	2.44	2.58	2.75	2.98	3.18	3.46	3.73	4.03	4.38	4.71
5.06	5.45	5.81	6.24	6.65	7.05	7.51	7.95	8.39	8.90	9.38
9.92	10.44	11.01	11.63	12.26	12.93	13.62	14.36	15.15	15.97	16.85
17.79	18.76	19.81	20.89	22.03	23.19	24.31	25.35	26.24	26.98	27.59
28.06	28.44	28.74	28.95	29.13	29.23	29.30	29.35	29.37	29.40	29.42
29.43	29.44	29.52	29.47	29.46	29.46	29.47	29.47	29.46	29.47	29.46

AUTOCAP LOT W. RAD FIRING NO. 5

.65	.64	.67	.73	.74	.80	.83	.86	.94	.97	1.02
1.11	1.15	1.26	1.30	1.38	1.50	1.56	1.66	1.80	1.89	2.04
2.14	2.26	2.46	2.60	2.82	3.00	3.23	3.54	3.83	4.13	4.50
4.82	5.22	5.56	5.95	6.39	6.80	7.24	7.71	8.16	8.65	9.13
9.64	10.21	10.76	11.36	11.97	12.63	13.35	14.07	14.85	15.68	16.54
17.47	18.44	19.49	20.60	21.75	22.95	24.12	25.26	26.27	27.11	27.74
28.33	28.77	29.11	29.36	29.55	29.68	29.76	29.82	29.86	29.88	29.90
29.92	29.93	29.93	29.94	29.95	29.95	29.95	29.95	29.95	29.95	29.95

AUTOCAP LOT W. RAD FIRING NO. 6

.58	.57	.59	.66	.67	.74	.76	.80	.89	.92	.97
1.07	1.10	1.21	1.26	1.34	1.46	1.52	1.66	1.76	1.87	2.03
2.14	2.29	2.48	2.62	2.84	3.02	3.26	3.58	3.85	4.21	4.55
4.88	5.26	5.63	6.01	6.45	6.85	7.30	7.73	8.20	8.72	9.20
9.72	10.29	10.85	11.48	12.09	12.75	13.47	14.20	15.01	15.85	16.72
17.67	18.65	19.73	20.87	22.00	23.20	24.37	25.47	26.43	27.23	27.87
28.38	28.78	29.09	29.32	29.49	29.60	29.69	29.73	29.7	29.80	29.82
29.82	29.83	29.84	29.85	29.85	29.85	29.86	29.86	29.8	29.86	29.85

AUTOCAP LOT LL. RAD FIRING NO. 1

1.15	1.23	1.26	1.33	1.42	1.47	1.57	1.62	1.70	1.80	1.87
1.95	2.07	2.15	2.26	2.34	2.43	2.56	2.65	2.79	2.98	3.0
3.20	3.37	3.58	3.82	4.03	4.30	4.55	4.83	5.15	5.44	5.75
6.11	6.46	6.86	7.24	7.64	8.10	8.53	9.01	9.49	9.97	10.50
11.04	11.60	12.21	12.81	13.47	14.13	14.83	15.61	16.39	17.22	18.12
19.03	20.03	21.04	22.07	23.10	24.05	24.90	25.61	26.20	26.69	27.06
27.37	27.61	27.78	27.92	28.00	28.07	28.11	28.14	28.17	28.18	28.20
28.21	28.21	28.22	28.22	28.23	28.22	28.22	28.23	28.22	28.26	28.23

AUTOCAP LOT LL. RAD FIRING NO. 2

.98	.99	1.05	1.14	1.17	1.25	1.35	1.46	1.51	1.57	1.65
1.76	1.83	1.92	2.06	2.13	2.26	2.35	2.46	2.63	2.75	2.94
3.09	3.28	3.52	3.72	3.96	4.23	4.48	4.78	5.05	5.35	5.70
6.01	6.39	6.77	7.13	7.56	7.96	8.39	8.86	9.31	9.82	10.30
10.84	11.41	11.97	12.57	13.23	13.89	14.61	15.37	16.14	16.99	17.87
18.82	19.80	20.83	21.90	22.97	23.95	24.84	25.60	26.22	26.73	27.13
27.45	27.70	27.87	28.01	28.10	28.16	28.20	28.22	28.24	28.25	28.26
28.27	28.27	28.27	28.28	28.28	28.28	28.28	28.28	28.27	28.27	28.27

AUTOCAP LOT LL. RAD FIRING NO. 3

.98	1.02	1.11	1.15	1.21	1.31	1.36	1.47	1.52	1.60	1.71
1.78	1.86	1.98	2.05	2.18	2.26	2.37	2.51	2.62	2.78	2.91
3.08	3.30	3.49	3.70	3.95	4.18	4.45	4.71	4.99	5.31	5.61
5.97	6.32	6.64	7.05	7.42	7.86	8.29	8.73	9.20	9.65	10.18
10.70	11.22	11.79	12.39	13.00	13.67	14.34	15.08	15.85	16.64	17.51
18.39	19.35	20.36	21.37	22.42	23.44	24.34	25.15	25.81	26.36	26.80
27.16	27.42	27.64	27.79	27.90	27.96	28.01	28.05	28.06	28.08	28.09
28.11	28.12	28.12	28.11	28.11	28.09	28.10	28.11	28.11	28.11	28.10

AUTOCAP LOT LL. RAD FIRING NO. 4

1.08	1.10	1.18	1.22	1.28	1.38	1.43	1.54	1 59	1.66	1.78
1.84	1.92	2.05	2.11	2.23	2.30	2.40	2.53	2.62	2.77	2.86
2.99	3.21	3.34	3.52	3.77	3.98	4.25	4.50	4.77	5.10	5.38
5.69	6.08	6.40	6.80	7.18	7.58	8.05	8.47	8.94	9.41	9.91
10.45	10.97	11.53	12.14	12.74	13.40	14.06	14.77	15.54	16.33	17.17
18.07	18.99	19.99	21.02	22.07	23.13	24.11	24.99	25.75	26.36	26.85
27.24	27.55	27.79	27.96	28.08	28.16	28.22	28.25	28.27	28.29	28.30
28.31	28.31	28.31	28.31	28.31	28.31	28.31	28.31	28.30	28.30	28.29

AUTOCAP LOT LL. RAD FIRING NO. 5

.86	.93	.98	1.06	1.09	1.19	1.27	1.31	1.38	1.47	1.54
1.65	1.71	1.80	1.93	2.00	2.13	2.21	2.32	2.47	2.57	2.69
2.87	3.00	3.21	3.40	3.61	3.88	4.11	4.36	4.65	4.92	5.24
5.54	5.88	6.26	6.61	7.01	7.39	7.82	8.26	8.72	9.18	9.68
10.19	10.73	11.27	11.86	12.47	13.11	13.80	14.50	15.24	16.05	16.87
17.76	18.72	19.69	20.75	21.84	22.92	23.99	24.95	25.74	26.45	27.01
27.45	27.79	28.05	28.25	28.37	28.47	28.53	28.57	28.59	28.60	28.62
28.62	28.63	28.64	28.63	28.63	28.63	28.63	28.62	28.62	28.61	28.61

AUTOCAP LOT LL. RAD FIRING NO. 6

.94	1.01	1.04	1.08	1.18	1.23	1.29	1.39	1.44	1.54	1.59
1.67	1.78	1.85	1.97	2.07	2.14	2.26	2.34	2.45	2.60	2.71
2.87	3.00	3.17	3.40	3.59	3.85	4.09	4.33	4.61	4.87	5.16
5.51	5.81	6.18	6.53	6.89	7.32	7.73	8.15	8.62	9.07	9.57
10.06	10.60	11.16	11.71	12.33	12.97	13.62	14.33	15.05	15.82	16.67
17.54	18.46	19.44	20.48	21.56	22.64	23.72	24.72	25.57	26.31	26.90
27.36	27.73	28.01	28.22	28.38	28.48	28.54	28.58	28.61	28.63	28.64
28.65	28.65	28.66	28.66	28.66	28.66	28.66	28.65	28.65	28.65	28.65

REFERENCE 68308 FOR LOTS (J-K-L). RAD FIRING NO. 1

.85	.85	.93	.96	1.01	1.11	1.15	1.21	1.32	1.36	1.47
1.53	1.61	1.73	1.80	1.92	2.00	2.14	2.26	2.36	2.50	2.69
2.87	3.11	3.32	3.56	3.83	4.07	4.34	4.64	4.92	5.24	5.54
5.87	6.25	6.59	6.99	7.38	7.79	8.25	8.68	9.15	9.67	10.18
10.73	11.28	11.88	12.53	13.16	13.84	14.59	15.34	16.16	16.98	17.87
18.82	19.80	20.80	21.87	22.93	23.94	24.84	25.62	26.26	26.77	27.18
27.52	27.78	27.99	28.13	28.24	28.32	28.37	28.41	28.43	28.46	28.48
28.49	28.51	28.51	28.52	28.53	28.53	28.53	28.54	28.53	28.54	28.53

REFERENCE 68308 FOR LOTS (J-K-L). RAD FIRING NO. 2

.86	.92	.95	.99	1.08	1.12	1.17	1.26	1.30	1.40	1.45
1.54	1.64	1.70	1.83	1.89	1.99	2.13	2.21	2.34	2.51	2.66
2.83	3.03	3.24	3.50	3.73	3.98	4.27	4.52	4.82	5.09	5.39
5.73	6.04	6.42	6.78	7.16	7.57	7.97	8.41	8.90	9.35	9.86
10.37	10.93	11.53	12.11	12.74	13.43	14.13	14.88	15.64	16.45	17.33
18.23	19.22	20.20	21.26	22.36	23.42	24.48	25.41	26.19	26.86	27.40
27.81	28.13	28.37	28.56	28.69	28.76	28.82	28.86	28.88	28.90	28.90
28.90	28.91	28.91	28.92	28.92	28.91	28.91	28.91	28.91	28.90	28.90

REFERENCE 68308 FOR LOTS (J-K-L). RAD FIRING NO. 3

1.02	1.08	1.11	1.18	1.21	1.27	1.36	1.40	1.49	1.52	1.60
1.71	1.76	1.85	1.97	2.03	2.16	2.25	2.34	2.47	2.57	2.70
2.87	3.02	3.22	3.43	3.65	3.93	4.16	4.46	4.71	4.99	5.32
5.63	5.97	6.34	6.69	7.11	7.48	7.89	8.34	8.78	9.28	9.76
10.25	10.80	11.35	11.93	12.56	13.19	13.89	14.59	15.34	16.14	16.96
17.83	18.77	19.74	20.78	21.85	22.94	24.01	25.01	25.88	26.62	27.23
27.70	28.08	28.37	28.59	28.75	28.86	28.93	28.98	29.00	29.03	29.04
29.05	29.07	29.07	29.08	29.08	29.07	29.07	29.06	29.06	29.06	29.06

REFERENCE 68308 FOR LOTS (J-K-L). RAD FIRING NO. 4

.93	1.00	1.02	1.07	1.15	1.19	1.29	1.33	1.39	1.49	1.54
1.65	1.70	1.78	1.91	1.98	2.07	2.21	2.29	2.43	2.53	2.67
2.86	3.02	3.20	3.47	3.67	3.94	4.15	4.43	4.73	5.01	5.33
5.62	5.95	6.32	6.66	7.04	7.45	7.85	8.30	8.73	9.19	9.70
10.20	10.73	11.31	11.88	12.51	13.15	13.83	14.58	15.32	16.13	16.96
17.85	18.81	19.80	20.85	21.92	23.00	24.07	25.04	25.88	26.59	27.17
27.56	27.99	28.28	28.51	28.67	28.78	28.85	28.91	28.94	28.97	28.99
28.99	29.01	29.02	29.03	29.04	29.04	29.05	29.04	29.04	29.04	29.05

REFERENCE 68308 FOR LOTS (J-K-L). RAD FIRING NO. 5

.92	.98	1.00	1.05	1.13	1.16	1.24	1.31	1.34	1.44	1.49
1.56	1.67	1.73	1.84	1.92	2.01	2.14	2.23	2.33	2.48	2.59
2.76	2.90	3.09	3.34	3.55	3.83	4.06	4.33	4.64	4.90	5.20
5.54	5.86	6.24	6.57	6.94	7.39	7.79	8.22	8.71	9.17	9.69
10.19	10.73	11.32	11.90	12.56	13.20	13.88	14.63	15.37	16.18	17.04
17.92	18.87	19.84	20.89	21.99	23.08	24.17	25.16	26.02	26.75	27.35
27.82	28.18	28.47	28.68	28.83	28.93	29.00	29.04	29.07	29.08	29.09
29.10	29.10	29.12	29.12	29.12	29.12	29.12	29.11	29.11	29.11	29.11

REFERENCE 68308 FOR LOTS (J-K-L). RAD FIRING NO. 6

.91	.97	1.00	1.05	1.13	1.16	1.25	1.29	1.36	1.46	1.5
1.61	1.67	1.75	1.88	1.95	2.04	2.18	2.26	2.40	2.50	2.
2.83	2.98	3.23	3.42	3.66	3.95	4.23	4.47	4.78	5.05	5.
5.69	6.03	6.42	6.77	7.15	7.58	8.00	8.47	8.90	9.38	9.9
10.42	10.99	11.55	12.15	12.81	13.46	14.16	14.92	15.68	16.51	17.36
18.27	19.24	20.24	21.29	22.37	23.44	24.45	25.37	26.14	26.78	27.30
27.71	28.02	28.26	28.44	28.57	28.66	28.72	28.75	28.78	28.80	28.81
28.81	28.83	28.83	28.84	28.84	28.84	28.84	28.84	28.84	28.84	28.83

REFERENCE 68308 FOR LOTS (JL-JKL). RAD FIRING NO. 1

.84	.82	.85	.94	.96	1.05	1.09	1.14	1.25	1.29	1.36
1.47	1.53	1.64	1.69	1.78	1.91	1.99	2.13	2.22	2.34	2.50
2.65	2.83	3.06	3.27	3.53	3.76	4.02	4.31	4.57	4.86	5.19
5.50	5.85	6.18	6.54	6.95	7.33	7.77	8.18	8.63	9.11	9.59
10.11	10.68	11.24	11.84	12.45	13.11	13.82	14.54	15.30	16.11	16.95
17.83	18.80	19.79	20.84	21.90	22.98	24.01	24.95	25.76	26.43	26.99
27.42	27.77	28.05	28.25	28.41	28.52	28.59	28.65	28.69	28.71	28.74
28.75	28.77	28.78	28.78	28.79	28.80	28.76	28.80	28.80	28.80	28.80

REFERENCE 68308 FOR LOTS (JL-JKL). RAD FIRING NO. 2

.87	.94	.96	1.04	1.07	1.12	1.22	1.26	1.32	1.42	1.47
1.57	1.63	1.70	1.82	1.89	1.98	2.11	2.19	2.33	2.43	2.56
2.74	2.89	3.12	3.32	3.56	3.84	4.07	4.36	4.66	4.93	5.23
5.55	5.90	6.29	6.63	7.01	7.44	7.85	8.30	8.74	9.21	9.75
10.25	10.81	11.36	11.96	12.62	13.26	13.96	14.71	15.47	16.30	17.14
18.05	19.02	20.02	21.10	22.21	23.32	24.40	25.38	26.22	26.92	27.48
27.92	28.26	28.53	28.73	28.86	28.96	29.01	29.09	29.09	29.09	29.11
29.08	29.11	29.13	29.14	29.13	29.13	29.13	29.13	29.13	29.13	29.13

REFERENCE 68308 FOR LOTS (JL-JKL). RAD FIRING NO. 3

.92	.93	.96	1.03	1.07	1.15	1.18	1.24	1.33	1.38	1.48
1.56	1.61	1.72	1.78	1.87	2.00	2.08	2.21	2.31	2.42	2.59
2.72	2.89	3.12	3.32	3.59	3.82	4.06	4.37	4.63	4.95	5.24
5.55	5.93	6.24	6.59	7.00	7.37	7.80	8.19	8.63	9.12	9.60
10.11	10.67	11.21	11.82	12.43	13.08	13.79	14.50	15.28	16.07	16.91
17.82	18.76	19.76	20.82	21.90	23.01	24.10	25.14	26.05	26.82	27.44
27.94	28.33	28.62	28.85	29.01	29.12	29.19	29.24	29.27	29.30	29.31
29.32	29.33	29.33	29.34	29.34	29.35	29.35	29.35	29.34	29.34	29.35

REFERENCE 68308 FOR LOTS (JL-JKL). RAD FIRING NO. 4

.83	.90	.91	.96	1.04	1.07	1.15	1.18	1.25	1.34	1.40
1.47	1.58	1.64	1.75	1.83	1.92	2.05	2.14	2.28	2.38	2.51
2.70	2.84	3.03	3.27	3.49	3.76	3.99	4.25	4.56	4.83	5.13
5.47	5.77	6.14	6.48	6.84	7.26	7.64	8.10	8.52	8.98	9.49
10.00	10.52	11.10	11.66	12.28	12.92	13.59	14.32	15.07	15.87	16.71
17.57	18.51	19.48	20.51	21.60	22.70	23.80	24.83	25.74	26.53	27.16
27.66	28.06	28.37	28.60	28.77	28.88	28.96	29.01	29.05	29.07	29.08
29.09	29.10	29.11	29.11	29.14	29.11	29.11	29.11	29.10	29.11	29.10

REFERENCE 68308 FOR LOTS (JL-JKL). RAD FIRING NO. 5

.87	.94	.96	1.00	1.09	1.12	1.17	1.26	1.31	1.37	1.44
1.52	1.63	1.69	1.82	1.88	1.97	2.11	2.19	2.30	2.46	2.57
2.76	2.91	3.04	3.34	3.56	3.85	4.11	4.35	4.65	4.91	5.22
5.57	5.89	6.27	6.62	7.00	7.43	7.84	8.27	8.76	9.23	9.74
10.25	10.80	11.39	11.96	12.64	13.28	13.98	14.76	15.51	16.32	17.20
18.10	19.06	20.07	21.13	22.23	23.33	24.39	25.37	26.18	26.87	27.42
27.85	28.20	28.46	28.65	28.79	28.89	28.96	29.00	29.02	29.05	29.06
29.08	29.08	29.09	29.10	29.10	29.10	29.10	29.10	29.11	29.10	29.10

REFERENCE 68308 FOR LOTS (JL-JKL). RAD FIRING NO. 6

.90	.97	.98	1.03	1.11	1.14	1.23	1.26	1.31	1.41	1.46
1.53	1.64	1.69	1.81	1.88	1.97	2.10	2.18	2.32	2.42	2.56
2.73	2.90	3.10	3.36	3.58	3.85	4.08	4.34	4.64	4.91	5.20
5.55	5.86	6.23	6.56	6.94	7.36	7.75	8.20	8.62	9.09	9.60
10.11	10.66	11.23	11.8	1 45	13.08	13.77	14.50	15.25	16.04	16.89
17.76	18.70	19.67	20.6	21.75	22.82	23.88	24.86	25.73	26.44	27.03
27.51	27.89	28.19	28.41	28.58	28.70	28.77	28.83	28.86	28.89	28.92
28.93	28.94	28.95	28.96	28.96	28.96	28.96	28.96	28.97	28.96	28.95

REFERENCE 68308 FOR LOTS(LL-JKLL). RAD FIRING NO. 1

.99	1.06	1.08	1.12	1.21	1.24	1.33	1.37	1.44	1.53	1.58
1.65	1.77	1.83	1.95	2.03	2.13	2.26	2.35	2.47	2.65	2.79
3.01	3.19	3.41	3.68	3.91	4.18	4.42	4.70	5.02	5.30	5.62
5.97	6.30	6.68	7.04	7.43	7.87	8.29	8.74	9.23	9.71	10.24
10.76	11.32	11.93	12.54	13.20	13.87	14.57	15.34	16.10	16.93	17.82
18.72	19.69	20.68	21.70	22.72	23.68	24.56	25.32	25.97	26.50	26.93
27.28	27.55	27.76	27.93	28.04	28.13	28.20	28.24	28.28	28.31	28.32
28.35	28.36	28.37	28.38	28.38	28.39	28.40	28.41	28.41	28.41	28.41

REFERENCE 68308 FOR LOTS(LL-JKLL). RAD FIRING NO. 2

.82	.82	.89	.91	.95	1.04	1.08	1.13	1.23	1.27	1.37
1.42	1.50	1.61	1.67	1.79	1.87	1.97	2.09	2.19	2.31	2.48
2.62	2.85	3.04	3.27	3.54	3.77	4.03	4.35	4.61	4.94	5.22
5.55	5.91	6.25	6.64	7.01	7.41	7.87	8.30	8.76	9.28	9.77
10.34	10.89	11.48	12.13	12.77	13.45	14.19	14.95	15.76	16.58	17.48
18.42	19.40	20.44	21.50	22.59	23.65	24.63	25.49	26.22	26.85	27.29
27.66	27.95	28.17	28.33	28.44	28.52	28.57	28.61	28.64	28.66	28.67
28.67	28.69	28.69	28.70	28.70	28.71	28.70	28.70	28.70	28.70	28.69

REFERENCE 68308 FOR LOTS(LL-JKLL). RAD FIRING NO. 3

.88	.96	.97	1.01	1.09	1.12	1.21	1.24	1.29	1.40	1.44
1.51	1.61	1.66	1.78	1.84	1.93	2.05	2.13	2.26	2.39	2.48
2.64	2.78	2.96	3.20	3.41	3.68	3.92	4.18	4.49	4.77	5.07
5.40	5.74	6.08	6.45	6.83	7.25	7.67	8.12	8.60	9.06	9.58
10.10	10.64	11.23	11.83	12.47	13.13	13.82	14.56	15.33	16.13	17.00
17.89	18.85	19.84	20.88	21.96	23.03	24.08	25.03	25.86	26.56	27.12
27.56	27.90	28.16	28.36	28.50	28.60	28.67	28.71	28.73	28.76	28.77
28.79	28.79	28.79	28.80	28.80	28.80	28.80	28.82	28.80	28.80	28.80

REFERENCE 68308 FOR LOTS(LL-JKLL). RAD FIRING NO. 4

.88	.94	.96	1.04	1.05	1.08	1.19	1.23	1.31	1.35	1.41
1.52	1.56	1.64	1.75	1.81	1.93	2.01	2.10	2.24	2.33	2.45
2.61	2.74	2.94	3.13	3.36	3.63	3.86	4.16	4.41	4.68	5.02
5.31	5.64	6.02	6.36	6.78	7.14	7.56	8.02	8.46	8.97	9.48
9.98	10.55	11.10	11.68	12.34	12.98	13.68	14.39	15.16	15.99	16.82
17.71	18.67	19.66	20.71	21.78	22.86	23.93	24.90	25.74	26.45	27.02
27.47	27.82	28.09	28.30	28.44	28.54	28.60	28.65	28.69	28.70	28.74
28.74	28.74	28.75	28.75	28.76	28.75	28.76	28.76	28.76	28.76	28.78

REFERENCE 68308 FOR LOTS(LL-JKLL). RAD FIRING NO. 5

.84	.85	.88	.96	.98	1.05	1.08	1.14	1.23	1.27	1.
1.41	1.49	1.60	1.66	1.74	1.87	1.94	2.07	2.15	2.26	2.40
2.51	2.66	2.86	3.05	3.30	3.52	3.77	4.07	4.32	4.63	4.91
5.24	5.59	5.91	6.28	6.69	7.06	7.50	7.93	8.38	8.88	9.39
9.92	10.49	11.05	11.68	12.30	12.98	13.71	14.44	15.23	16.04	16.90
17.83	18.80	19.82	20.89	21.99	23.11	24.19	25.16	26.02	26.71	27.27
27.71	28.05	28.30	28.49	28.62	28.71	28.76	28.80	28.83	28.85	28.87
28.88	28.88	28.89	28.89	28.89	28.89	28.89	28.89	28.89	28.88	28.88

REFERENCE 68308 FOR LOTS(LL-JKLL). RAD FIRING NO. 6

.96	.97	1.00	1.07	1.10	1.15	1.24	1.27	1.36	1.40	1.47
1.57	1.62	1.70	1.82	1.89	2.01	2.08	2.19	2.34	2.45	2.63
2.79	2.99	3.23	3.45	3.69	3.97	4.22	4.51	4.78	5.07	5.40
5.71	6.04	6.41	6.78	7.17	7.54	7.98	8.44	8.88	9.40	9.87
10.38	10.96	11.50	12.10	12.76	13.40	14.11	14.83	15.60	16.42	17.28
18.18	19.13	20.13	21.20	22.27	23.36	24.40	25.33	26.14	26.80	27.34
27.76	28.09	28.30	28.50	28.63	28.74	28.80	28.84	28.87	28.89	28.91
28.92	28.92	28.94	28.94	28.93	28.93	28.94	28.94	28.94	28.93	28.93

REFERENCE 68308 FOR LOTS (M-N). RAD FIRING NO. 1

.84	.85	.87	.95	.97	1.05	1.08	1.14	1.24	1.28	1.38
1.44	1.51	1.63	1.70	1.79	1.92	1.99	2.08	2.20	2.31	2.46
2.57	2.70	2.89	3.04	3.28	3.48	3.72	4.01	4.26	4.58	4.85
5.15	5.50	5.83	6.18	6.57	6.94	7.36	7.78	8.23	8.71	9.19
9.69	10.24	10.81	11.42	12.03	12.66	13.36	14.07	14.84	15.62	16.45
17.34	18.25	19.23	20.26	21.33	22.43	23.52	24.57	25.49	26.25	26.89
27.40	27.79	28.09	28.34	28.51	28.63	28.71	28.76	28.80	28.82	28.84
28.85	28.87	28.87	28.88	28.88	28.88	28.89	28.89	28.89	28.88	28.88

REFERENCE 68308 FOR LOTS (M-N). RAD FIRING NO. 2

.80	.83	.89	.93	1.01	1.03	1.09	1.17	1.21	1.27	1.37
1.41	1.51	1.56	1.63	1.74	1.81	1.90	2.03	2.10	2.24	2.34
2.48	2.66	2.82	3.05	3.25	3.49	3.76	4.01	4.28	4.59	4.86
5.19	5.49	5.82	6.20	6.54	6.95	7.35	7.76	8.21	8.66	9.15
9.67	10.20	10.77	11.34	11.94	12.61	13.27	13.98	14.75	15.53	16.36
17.23	18.16	19.14	20.18	21.26	22.35	23.45	24.51	25.45	26.25	26.92
27.44	27.85	28.17	28.40	28.58	28.69	28.78	28.83	28.87	28.88	28.89
28.91	28.92	28.92	28.93	28.93	28.92	28.93	28.92	28.92	28.92	28.91

REFERENCE 68308 FOR LOTS (M-N). RAD FIRING NO. 3

.87	.86	.89	.97	1.00	1.08	1.12	1.17	1.27	1.31	1.41
1.46	1.54	1.65	1.71	1.81	1.94	2.01	2.15	2.23	2.34	2.49
2.60	2.77	2.90	3.08	3.33	3.53	3.78	4.06	4.31	4.61	4.90
5.21	5.57	5.88	6.22	6.62	7.00	7.44	7.85	8.30	8.74	9.23
9.77	10.28	10.84	11.44	12.03	12.67	13.37	14.06	14.82	15.60	16.42
17.33	18.24	19.22	20.26	21.33	22.45	23.56	24.65	25.63	26.47	27.16
27.72	28.14	28.48	28.74	28.92	29.05	29.13	29.19	29.22	29.24	29.26
29.27	29.28	29.28	29.28	29.28	29.27	29.28	29.28	29.27	29.27	29.27

REFERENCE 68308 FOR LOTS (M-N). RAD FIRING NO. 4

.82	.88	.89	.94	1.02	1.04	1.10	1.19	1.22	1.32	1.36
1.42	1.53	1.59	1.70	1.76	1.85	1.99	2.07	2.17	2.32	2.42
2.59	2.73	2.91	3.15	3.36	3.63	3.89	4.14	4.44	4.69	4.97
5.30	5.61	5.99	6.35	6.71	7.12	7.50	7.92	8.39	8.83	9.33
9.83	10.36	10.93	11.50	12.13	12.77	13.44	14.17	14 91	15.70	16.55
17.40	18.33	19.31	20.34	21.44	22.55	23.68	24.74	25.69	26.51	27.19
27.73	28.16	28.48	28.73	28.91	29.04	29.13	29.18	29.22	29.23	29.25
29.25	29.26	29.27	29.27	29.27	29.27	29.28	29.27	29.26	29.26	29.26

REFERENCE 68308 FOR LOTS (M-N). RAD FIRING NO. 5

.79	.79	.83	.90	.92	.97	1.05	1.09	1.18	1.22	1.28
1.39	1.44	1.54	1.63	1.69	1.81	1.88	1.98	2.12	2.22	2.37
2.49	2.65	2.87	3.05	3.31	3.56	3.78	4.06	4.32	4.60	4.92
5.20	5.55	5.88	6.23	6.62	6.98	7.37	7.82	8.25	8.73	9.20
9.70	10.24	10.79	11.38	12.01	12.65	13.34	14.04	14.79	15.60	16.43
17.32	18.25	19.24	20.29	21.36	22.48	23.61	24.66	25.62	26.43	27.09
27.61	28.02	28.33	28.57	28.74	28.87	28.94	28.99	29.02	29.05	29.06
29.06	29.07	29.07	29.08	29.08	29.08	29.08	29.08	29.08	29.07	29.07

REFERENCE 68308 FOR LOTS (M-N). RAD FIRING NO. 6

.85	.91	.93	1.00	1.02	1.06	1.15	1.19	1.27	1.31	1.37
1.47	1.53	1.60	1.71	1.78	1.90	1.98	2.08	2.21	2.30	2.41
2.58	2.72	2.93	3.11	3.34	3.61	3.84	4.13	4.38	4.66	4.97
5.25	5.58	5.95	6.29	6.69	7.08	7.49	7.94	8.37	8.86	9.37
9.86	10.41	10.97	11.56	12.21	12.87	13.57	14.28	15.05	15.88	16.73
17.63	18.60	19.59	20.66	21.75	22.94	24.00	25.00	25.91	26.63	27.24
27.72	28.08	28.36	28.57	28.72	28.82	28.88	28.92	28.95	28.96	28.98
28.99	28.99	28.99	28.99	28.99	28.99	28.99	28.99	28.98	28.97	28.96

REFERENCE 68308 FOR LOTS (P-T). RAD FIRING NO. 1

1.00	1.04	1.11	1.14	1.23	1.26	1.31	1.41	1.45	1.52	1.62
1.67	1.78	1.85	1.93	2.06	2.14	2.28	2.36	2.50	2.66	2.77
2.94	3.17	3.37	3.64	3.86	4.11	4.41	4.66	4.95	5.28	5.58
5.93	6.27	6.63	7.05	7.43	7.88	8.30	8.76	9.25	9.74	10.25
10.82	11.37	11.99	12.60	13.25	13.96	14.65	15.41	16.22	17.04	17.93
18.85	19.82	20.87	21.91	23.00	24.05	25.07	25.98	26.76	27.41	27.94
28.35	28.68	28.94	29.13	29.27	29.37	29.43	29.48	29.51	29.53	29.55
29.56	29.57	29.58	29.59	29.59	29.58	29.58	29.58	29.58	29.58	29.58

REFERENCE 68308 FOR LOTS (P-T). RAD FIRING NO. 2

.96	1.02	1.05	1.12	1.15	1.20	1.29	1.34	1.39	1.50	1.54
1.65	1.70	1.78	1.90	1.97	2.07	2.20	2.28	2.43	2.54	2.66
2.85	3.01	3.25	3.45	3.68	3.97	4.21	4.46	4.79	5.04	5.39
5.68	6.02	6.42	6.76	7.17	7.59	8.01	8.48	8.94	9.43	9.96
10.49	11.06	11.64	12.24	12.91	13.58	14.29	15.06	15.82	16.67	17.53
18.44	19.43	20.44	21.50	22.62	23.72	24.79	25.77	26.60	27.32	27.90
28.36	28.73	29.01	29.22	29.37	29.49	29.56	29.61	29.64	29.63	29.68
29.69	29.70	29.72	29.71	29.71	29.72	29.72	29.71	29.71	29.70	29.70

REFERENCE 68308 FOR LOTS (P-T). RAD FIRING NO. 3

.92	.99	1.00	1.09	1.11	1.16	1.25	1.29	1.35	1.45	1.49
1.61	1.66	1.74	1.86	1.93	2.03	2.16	2.26	2.40	2.51	2.66
2.87	3.05	3.29	3.51	3.74	4.02	4.27	4.54	4.85	5.13	5.45
5.76	6.10	6.46	6.83	7.22	7.64	8.05	8.49	8.96	9.45	9.97
10.52	11.10	11.68	12.31	12.97	13.64	14.37	15.14	15.93	16.80	17.68
18.62	19.63	20.66	21.77	22.90	24.04	25.14	26.13	26.98	27.68	28.25
28.69	29.04	29.30	29.48	29.63	29.72	29.77	29.85	29.86	29.86	29.88
29.89	29.89	29.90	29.90	29.90	29.90	29.90	29.89	29.90	29.89	29.89

REFERENCE 68308 FOR LOTS (P-T). RAD FIRING NO. 4

.92	.99	1.00	1.05	1.14	1.17	1.22	1.32	1.36	1.45	1.50
1.57	1.69	1.75	1.87	1.93	2.04	2.17	2.25	2.38	2.53	2.65
2.87	3.04	3.22	3.47	3.70	3.94	4.23	4.49	4.80	5.08	5.38
5.73	6.06	6.43	6.79	7.17	7.59	8.00	8.45	8.93	9.42	9.94
10.45	11.01	11.62	12.22	12.87	13.57	14.27	15.05	15.84	16.66	17.57
18.50	19.49	20.52	21.63	22.76	23.89	25.00	26.03	26.89	27.64	28.24
28.68	29.06	29.34	29.55	29.70	29.79	29.86	29.89	29.92	29.94	29.96
29.97	29.96	29.97	29.98	29.97	29.97	29.98	29.97	29.98	29.98	29.97

REFERENCE 68308 FOR LOTS (P-T). RAD FIRING NO. 5

.84	.91	.93	1.00	1.03	1.08	1.17	1.21	1.27	1.37	1.42
1.53	1.58	1.66	1.77	1.85	1.94	2.08	2.16	2.30	2.40	2.56
2.73	2.90	3.11	3.33	3.55	3.81	4.07	4.34	4.64	4.92	5.24
5.54	5.88	6.24	6.60	6.98	7.41	7.81	8.28	8.72	9.19	9.72
10.22	10.78	11.35	11.94	12.59	13.25	13.95	14.70	15.46	16.29	17.14
18.04	19.02	20.01	21.09	22.20	23.33	24.46	25.51	26.49	27.31	27.98
28.52	28.93	29.28	29.51	29.69	29.81	29.90	29.94	29.98	30.00	30.02
30.03	30.03	30.04	30.04	30.04	30.10	30.06	30.04	30.04	30.04	30.04

REFERENCE 68308 FOR LOTS (P-T). RAD FIRING NO. 6

.90	.91	.92	1.01	1.04	1.12	1.19	1.23	1.3	1.36	1.43
1.53	1.59	1.70	1.76	1.85	1.97	2.03	2.15	2.30	2.38	2.53
2.65	2.78	2.96	3.12	3.32	3.57	3.81	4.10	4.34	4.63	4.97
5.25	5.62	5.97	6.34	6.75	7.14	7.58	8.06	8.54	9.02	9.52
10.05	10.61	11.18	11.80	12.46	13.10	13.83	14.56	15.33	16.16	17.01
17.95	18.89	19.90	20.97	22.08	23.23	24. 7	25.44	26.43	27.26	27.95
28.51	28.95	29.28	29.54	29.73	29.87	29.95	30.01	30.05	30.08	30.10
30.11	30.12	30.13	30.14	30.14	30.14	30.14	30.14	30.14	30.13	30.14

REFERENCE 68308 FOR LOTS (Q-U). RAD FIRING NO. 1

.89	.95	.98	1.02	1.10	1.14	1.23	1.27	1.33	1.43	1.48
1.58	1.64	1.72	1.84	1.91	2.00	2.14	2.23	2.36	2.46	2.59
2.77	2.91	3.10	3.35	3.57	3.83	4.06	4.33	4.65	4.91	5.24
5.54	5.87	6.24	6.60	6.97	7.40	7.80	8.26	8.71	9.19	9.72
10.22	10.80	11.39	11.98	12.64	13.29	14.(	14.78	15.54	16.38	17.24
18.16	19.16	20.18	21.27	22.40	23.55	24.66	25.72	26.65	27.45	28.08
28.60	29.00	29.30	29.54	29.71	29.83	29.91	29.96	30.02	30.03	30.04
30.05	30.06	30.07	30.09	30.09	30.08	30.08	30.08	30.08	30.08	30.07

REFERENCE 68308 FOR LOTS (Q-U). RAD FIRING NO. 2

.73	.79	.81	.86	.94	.97	1.06	1.10	1.16	1.26	1.31
1.38	1.50	1.55	1.67	1.73	1.83	1.96	2.04	2.19	2.32	2.43
2.60	2.77	2.99	3.23	3.45	3.72	3.96	4.22	4.53	4.80	5.11
5.45	5.77	6.15	6.49	6.88	7.31	7.72	8.18	8.63	9.11	9.63
10.15	10.70	11.31	11.91	12.57	13.23	13.94	14.72	15.50	16.33	17.23
18.14	19.14	20.16	21.24	22.41	23.55	24.69	25.77	26.71	27.53	28.13
28.64	29.05	29.35	29.58	29.74	29.85	29.93	29.98	30.00	30.03	30.05
30.06	30.07	30.05	30.07	30.07	30.07	30.07	30.07	30.07	30.06	30.06

REFERENCE 68308 FOR LOTS (Q-U). RAD FIRING NO. 3

.88	.88	.92	.99	1.03	1.11	1.13	1.18	1.28	1.33	1.40
1.50	1.56	1.66	1.73	1.82	1.96	2.03	2.17	2.26	2.39	2.56
2.68	2.84	3.07	3.26	3.54	3.76	4.03	4.33	4.59	4.89	5.22
5.52	5.88	6.20	6.56	6.98	7.36	7.81	8.23	8.67	9.17	9.65
10.18	10.76	11.32	11.94	12.56	13.23	13.96	14.69	15.47	16.31	17.13
18.12	19.09	20.13	21.23	22.39	23.56	24.73	25.85	26.87	27.72	28.43
28.99	29.42	29.75	30.01	30.19	30.32	30.40	30.45	30.49	30.51	30.52
30.54	30.55	30.56	30.56	30.56	30.57	30.57	30.57	30.57	30.56	30.56

REFERENCE 68308 FOR LOTS (Q-U). RAD FIRING NO. 4

.87	.87	.90	.98	1.01	1.06	1.14	1.18	1.28	1.32	1.37
1.48	1.55	1.60	1.69	1.79	1.92	2.00	2.11	2.26	2.36	2.52
2.64	2.81	3.05	3.24	3.48	3.75	3.98	4.27	4.53	4.82	5.15
5.44	5.79	6.10	6.45	6.85	7.22	7.63	8.09	8.52	9.00	9.48
9.99	10.54	11.09	11.69	12.34	12.98	13.69	14.41	15.19	16.01	16.86
17.80	18.73	19.74	20.82	21.94	23.09	24.26	25.39	26.41	27.28	28.01
28.59	29.04	29.40	29.67	29.86	30.00	30.10	30.16	30.19	30.22	30.24
30.24	30.25	30.25	30.26	30.27	30.27	30.27	30.27	30.26	30.26	30.26

REFERENCE 68308 FOR LOTS (Q-U). RAD FIRING NO. 5

.80	.80	.88	.90	.94	1.03	1.07	1.15	1.18	1.25	1.35
1.40	1.47	1.59	1.65	1.76	1.84	1.93	2.06	2.15	2.26	2.42
2.53	2.70	2.85	3.04	3.29	3.51	3.79	4.00	4.29	4.61	4.89
5.19	5.54	5.83	6.26	6.61	6.99	7.42	7.84	8.29	8.78	9.25
9.79	10.31	10.88	11.49	12.10	12.77	13.45	14.17	14.96	15.75	16.60
17.51	18.45	19.46	20.52	21.63	22.80	23.97	25.11	26.18	27.11	27.88
28.50	28.99	29.37	29.65	29.86	30.03	30.12	30.18	30.21	30.25	30.29
30.29	30.30	30.30	30.30	30.31	30.31	30.32	30.32	30.32	30.32	30.31

REFERENCE 68308 FOR LOTS (Q-U). RAD FIRING NO. 6

.86	.86	.89	.94	.99	1.07	1.08	1.16	1.26	1.28	1.36
1.47	1.53	1.65	1.71	1.80	1.90	2.01	2.15	2.24	2.35	2.52
2.65	2.81	3.03	3.22	3.48	3.70	3.95	4.26	4.52	4.81	5.14
5.43	5.79	6.12	6.49	6.90	7.30	7.74	8.17	8.63	9.14	9.63
10.16	10.72	11.30	11.93	12.56	13.24	13.98	14.71	15.50	16.35	17.22
18.16	19.14	20.18	21.29	22.42	23.60	24.75	25.83	26.79	27.59	28.25
28.77	29.17	29.49	29.72	29.89	30.00	30.08	30.13	30.16	30.19	30.20
30.21	30.21	30.22	30.22	30.23	30.24	30.24	30.23	30.23	30.23	30.22

REFERENCE 68308 FOR LOTS (R-S). RAD FIRING NO. 1

.75	.82	.84	.92	.95	.99	1.09	1.12	1.18	1.29	1.34
1.45	1.50	1.58	1.70	1.77	1.89	1.97	2.08	2.23	2.33	2.46
2.64	2.79	3.02	3.23	3.47	3.75	3.99	4.26	4.58	4.86	5.19
5.49	5.83	6.21	6.56	6.97	7.33	7.76	8.23	8.72	9.16	9.68
10.19	10.76	11.32	11.93	12.59	13.25	13.96	14.72	15.49	16.32	17.18
18.10	19.08	20.09	21.18	22.30	23.46	24.62	25.73	26.71	27.57	28.26
28.81	29.24	29.58	29.85	30.04	30.17	30.26	30.32	30.36	30.39	30.40
30.42	30.43	30.44	30.46	30.46	30.48	30.50	30.46	30.46	30.46	30.46

REFERENCE 68308 FOR LOTS (R-S). RAD FIRING NO. 2

.80	.87	.89	.93	1.02	1.06	1.14	1.18	1.24	1.35	1.40
1.47	1.58	1.65	1.76	1.83	1.93	2.06	2.15	2.29	2.39	2.53
2.71	2.86	3.06	3.32	3.53	3.80	4.05	4.32	4.62	4.90	5.21
5.55	5.98	6.23	6.59	6.97	7.39	7.78	8.25	8.70	9.19	9.71
10.21	10.77	11.37	11.96	12.63	13.28	13.98	14.75	15.53	16.37	17.25
18.16	19.14	20.16	21.24	22.39	23.54	24.70	25.77	26.72	27.53	28.18
28.69	29.10	29.41	29.65	29.83	29.91	30.00	30.06	30.08	30.11	30.13
30.14	30.15	30.16	30.17	30.17	30.18	30.17	30.17	30.18	30.18	30.17

REFERENCE 68308 FOR LOTS (R-S). RAD FIRING NO. 3

.83	.81	.84	.91	.94	.98	1.07	1.10	1.20	1.24	1.30
1.40	1.45	1.53	1.63	1.71	1.83	1.90	2.00	2.14	2.25	2.39
2.52	2.67	2.87	3.14	3.31	3.58	3.81	4.11	4.36	4.64	4.97
5.27	5.58	5.96	6.30	6.71	7.08	7.48	7.95	8.37	8.87	9.34
9.85	10.41	10.97	11.57	12.22	12.85	13.56	14.28	15.04	15.87	16.72
17.62	18.59	19.58	20.66	21.78	22.95	24.15	25.30	26.37	27.30	28.08
28.71	29.20	29.54	29.89	30.06	30.24	30.35	30.42	30.47	30.49	30.51
30.54	30.54	30.55	30.56	30.57	30.58	30.58	30.58	30.57	30.57	30.57

REFERENCE 68308 FOR LOTS (R-S). RAD FIRING NO. 4

.81	.82	.85	.92	.95	1.00	1.09	1.12	1.21	1.25	1.31
1.42	1.47	1.58	1.63	1.72	1.84	1.91	2.01	2.15	2.24	2.39
2.49	2.65	2.85	3.01	3.23	3.51	3.74	4.03	4.29	4.58	4.91
5.21	5.57	5.89	6.24	6.65	7.02	7.44	7.91	8.34	8.84	9.32
9.83	10.40	10.96	11.56	12.22	12.86	13.58	14.30	15.08	15.91	16.76
17.68	18.64	19.64	20.72	21.84	23.01	24.19	25.33	26.38	27.29	28.03
28.64	29.10	29.48	29.77	29.96	30.12	30.22	30.29	30.32	30.36	30.38
30.40	30.40	30.41	30.42	30.44	30.46	30.45	30.44	30.45	30.44	30.44

REFERENCE 68308 FOR LOTS (R-S). RAD FIRING NO. 5

.81	.87	.89	.93	1.02	1.05	1.13	1.16	1.22	1.32	1.37
1.44	1.55	1.60	1.72	1.79	1.88	2.01	2.10	2.21	2.35	2.47
2.64	2.78	2.96	3.21	3.42	3.69	3.93	4.21	4.51	4.78	5.08
5.52	5.77	6.14	6.49	6.87	7.29	7.69	8.13	8.62	9.08	9.61
10.12	10.67	11.26	11.86	12.52	13.18	13.88	14.62	15.41	16.25	17.14
18.04	19.04	20.05	21.14	22.29	23.45	24.62	25.74	26.73	27.59	28.27
28.84	29.16	29.60	29.85	30.03	30.16	30.24	30.30	30.32	30.34	30.37
30.38	30.39	30.40	30.42	30.42	30.43	30.43	30.43	30.43	30.43	30.40

REFERENCE 68308 FOR LOTS (R-S). RAD FIRING NO. 6

.84	.86	.96	.98	1.11	1.10	1.14	1.22	1.26	1.35	1.40
1.46	1.56	1.63	1.72	1.84	1.91	2.03	2.11	2.22	2.37	2.47
2.60	2.78	2.93	3.16	3.36	3.61	3.89	4.14	4.44	4.71	5.00
5.35	5.67	6.01	6.40	6.75	7.18	7.58	8.01	8.48	8.93	9.43
9.97	10.51	11.07	11.65	12.28	12.96	13.64	14.38	15.12	15.92	16.79
17.67	18.61	19.63	20.66	21.77	22.90	24.04	25.13	26.11	26.95	27.66
28.23	28.67	29.02	29.27	29.46	29.61	29.70	29.75	29.79	29.82	29.84
29.86	29.86	29.88	29.89	29.90	29.91	29.88	29.89	29.89	29.90	29.88

REFERENCE 68308 FOR LOTS (V-W). RAD FIRING NO. 1

.84	.84	.87	.94	.97	1.05	1.09	1.14	1.23	1.27	1.34
1.44	1.50	1.60	1.66	1.75	1.88	1.95	2.05	2.19	2.29	2.44
2.55	2.70	2.92	3.01	3.33	3.55	3.79	4.09	4.35	4.63	4.96
5.25	5.61	5.94	6.29	6.69	7.07	7.48	7.94	8.36	8.86	9.33
9.84	10.40	10.94	11.56	12.16	12.82	13.53	14.23	14.99	15.81	16.64
17.56	18.49	19.48	20.56	21.64	22.79	23.95	25.04	26.06	26.92	27.64
28.22	28.68	29.04	29.31	29.54	29.68	29.78	29.84	29.89	29.92	29.94
29.96	29.97	29.99	30.00	30.01	30.03	30.02	30.01	30.01	30.02	30.02

REFERENCE 68308 FOR LOTS (V-W). RAD FIRING NO. 2

.76	.79	.87	.89	.94	1.02	1.06	1.14	1.18	1.24	1.34
1.40	1.50	1.55	1.63	1.76	1.84	1.94	2.08	2.17	2.31	2.41
2.55	2.72	2.86	3.04	3.27	3.49	3.75	3.99	4.26	4.57	4.84
5.18	5.49	5.84	6.20	6.53	6.92	7.37	7.79	8.26	8.71	9.20
9.74	10.26	10.82	11.43	12.03	12.71	13.39	14.11	14.90	15.69	16.55
17.43	18.39	19.41	20.46	21.59	22.76	23.93	25.11	26.18	27.13	27.92
28.55	29.05	29.45	29.74	29.97	30.11	30.20	30.30	30.35	30.38	30.41
30.42	30.45	30.43	30.44	30.46	30.46	30.46	30.47	30.46	30.47	30.46

REFERENCE 68308 FOR LOTS (V-W). RAD FIRING NO. 3

.83	.82	.89	.91	.96	1.06	.98	1.20	1.25	1.42	1.34
1.45	1.51	1.62	1.72	1.82	1.89	1.98	2.12	2.21	2.32	2.48
2.59	2.78	2.93	3.13	3.39	3.62	3.89	4.15	4.42	4.75	5.03
5.35	5.70	6.02	6.41	6.77	7.18	7.72	8.12	8.52	9.05	9.52
10.05	10.58	11.17	11.79	12.42	13.10	13.80	14.55	15.36	16.17	17.05
17.99	18.96	20.01	21.10	22.25	23.44	24.62	25.75	26.76	27.61	28.32
28.89	29.32	29.66	29.91	30.10	30.22	30.31	30.37	30.40	30.43	30.45
30.46	30.48	30.48	30.49	30.50	30.50	30.50	30.52	30.53	30.51	30.51

REFERENCE 68308 FOR LOTS (V-W). RAD FIRING NO. 4

.85	.92	.94	.99	1.08	1.11	1.16	1.26	1.30	1.40	1.44
1.51	1.62	1.68	1.79	1.86	1.96	2.09	2.17	2.29	2.44	2.55
2.73	2.87	3.06	3.30	3.52	3.76	4.03	4.28	4.57	4.84	5.14
5.45	5.77	6.12	6.48	6.92	7.29	7.66	8.09	8.57	9.02	9.52
10.01	10.55	11.13	11.73	12.36	13.00	13.68	14.41	15.17	15.97	16.82
17.71	18.66	19.64	20.69	21.80	22.95	24.11	25.26	26.29	27.20	27.95
28.56	29.04	29.41	29.71	29.92	30.07	30.18	30.24	30.30	30.33	30.35
30.41	30.39	30.36	30.39	30.41	30.42	30.43	30.43	30.44	30.43	30.43

REFERENCE 68308 FOR LOTS (V-W). RAD FIRING NO. 5

.86	.93	.95	.99	1.07	1.10	1.20	1.23	1.28	1.39	1.43
1.54	1.59	1.68	1.78	1.89	1.97	2.10	2.19	2.33	2.43	2.57
2.76	2.93	3.14	3.41	3.62	3.89	4.13	4.39	4.70	4.96	5.30
5.59	5.92	6.30	6.64	7.02	7.44	7.84	8.30	8.75	9.22	9.74
10.24	10.80	11.38	11.96	12.61	13.25	13.94	14.68	15.44	16.28	17.13
18.03	18.99	19.99	21.07	22.19	23.32	24.45	25.50	26.44	27.24	27.89
28.41	28.82	29.13	29.37	29.55	29.66	29.75	29.81	29.84	29.87	29.89
29.91	29.92	29.92	29.93	29.94	29.94	29.94	29.95	29.94	29.94	29.94

REFERENCE 68308 FOR LOTS (V-W). RAD FIRING NO. 6

.80	.79	.83	.91	.94	.98	1.07	1.10	1.20	1.23	1.29
1.40	1.45	1.56	1.62	1.71	1.84	1.92	1.99	2.15	2.24	2.39
2.50	2.65	2.85	3.03	3.23	3.52	3.76	4.05	4.31	4.60	4.93
5.21	5.62	5.91	6.25	6.66	7.04	7.47	7.93	8.36	8.86	9.33
9.85	10.42	10.99	11.59	12.25	12.91	13.64	14.38	15.16	16.00	16.86
17.79	18.76	19.80	20.90	22.05	23.23	24.43	25.57	26.62	27.51	28.26
28.84	29.31	29.68	29.94	30.14	30.29	30.39	30.45	30.46	30.52	30.57
30.57	30.58	30.59	30.59	30.61	30.62	30.62	30.62	30.62	30.62	30.62

SIX HEX RECORDS. TEST NO. 29.

2.075	2.097	2.187	2.316	2.419	2.556	2.701	2.835	3.015	3.211
3.446	3.590	3.790	3.999	4.225	4.455	4.716	4.919	5.183	5.386
5.650	5.916	6.164	6.426	6.700	6.951	7.262	7.513	7.789	8.124
8.394	8.737	9.054	9.363	9.729	10.061	10.428	10.830	11.224	11.633
12.028	12.455	12.926	13.381	13.845	14.383	14.899	15.463	15.999	16.599
17.229	17.852	18.545	19.233	19.934	20.712	21.475	22.287	23.098	23.883
24.629	25.331	25.923	26.449	26.886	27.258	27.586	27.832	28.044	28.213
28.339	28.433	28.514	28.579	28.595	28.635	28.645	28.643	28.642	28.646
28.652	28.644	28.656	28.650	28.653	28.631	28.635	28.636	28.623	28.628

SIX HEX RECORDS. TEST NO. 36.

-3.764	-3.718	-3.676	-3.655	-3.477	-3.504	-3.403	-3.389	-3.298	-3.179
-3.139	-3.058	-2.946	-2.865	-2.740	-2.684	-2.563	-2.405	-2.320	-2.151
-2.053	-1.917	-1.740	-1.594	-1.400	-1.128	-.912	-.604	-.359	-.064
.310	.612	.967	1.372	1.702	2.089	2.435	2.878	3.370	3.854
4.372	4.842	5.397	5.974	6.545	7.100	7.869	8.580	9.323	10.083
10.889	11.797	12.686	13.722	14.759	15.832	17.011	18.216	19.499	20.863
22.226	23.579	24.858	26.028	27.027	27.846	28.473	29.002	29.378	29.675
29.892	30.018	30.120	30.181	30.242	30.253	30.260	30.272	30.275	30.312
30.311	30.326	30.294	30.316	30.322	30.318	30.338	30.444	30.344	30.314

SIX HEX RECORDS. TEST NO. 45.

.875	.836	.888	.989	1.001	1.053	1.159	1.181	1.276	1.335
1.394	1.510	1.575	1.697	1.755	1.835	1.989	2.062	2.165	2.337
2.433	2.599	2.729	2.926	3.157	3.334	3.565	3.844	4.087	4.378
4.646	4.939	5.278	5.584	5.945	6.287	6.612	7.039	7.412	7.811
8.279	8.693	9.195	9.675	10.199	10.773	11.333	11.961	12.605	13.289
14.001	14.738	15.520	16.372	17.237	18.171	19.145	20.177	21.273	22.371
23.493	24.593	25.617	26.551	27.321	27.975	28.497	28.903	29.235	29.477
29.657	29.791	29.882	29.892	29.983	30.001	30.028	30.039	30.073	30.108
30.063	30.043	30.056	30.064	30.066	30.062	30.061	30.052	30.041	30.042

SIX HEX RECORDS. REF NO. 26.

.828	.805	.884	.904	.940	1.020	1.049	1.149	1.187	1.246
1.349	1.393	1.466	1.577	1.654	1.757	1.823	1.924	2.064	2.157
2.242	2.383	2.507	2.698	2.834	3.024	3.262	3.477	3.765	4.015
4.281	4.605	4.890	5.219	5.594	5.936	6.332	6.670	7.074	7.539
7.948	8.423	8.923	9.412	9.973	10.490	11.050	11.691	12.313	13.014
13.681	14.407	15.192	15.902	16.856	17.796	18.731	19.759	20.792	21.916
23.088	24.251	25.353	26.343	27.220	27.963	28.516	28.948	29.295	29.568
29.756	29.870	29.965	30.028	30.044	30.075	30.087	30.077	30.083	30.107
30.081	30.097	30.093	30.087	30.085	30.067	30.076	30.061	30.052	30.055

SIX HEX RECORDS. REF NO. 34.

.804	.902	.935	.979	1.075	1.045	1.167	1.202	1.273	1.375
1.423	1.532	1.569	1.649	1.762	1.804	1.890	2.032	2.094	2.238
2.297	2.409	2.580	2.689	2.819	3.011	3.148	3.400	3.610	3.863
4.144	4.423	4.747	5.054	5.398	5.773	6.125	6.515	6.960	7.373
7.841	8.296	8.779	9.367	9.830	10.368	10.974	11.521	12.210	12.862
13.568	14.305	15.058	15.891	16.736	17.623	18.592	19.608	20.663	21.811
22.952	24.114	25.249	26.320	27.198	27.955	28.558	29.038	29.398	29.679
29.892	30.025	30.139	30.202	30.245	30.274	30.285	30.297	30.291	30.298
30.305	30.311	30.317	30.314	30.313	30.286	30.306	30.302	30.332	30.300

SIX HEX RECORDS. REF NO. 42.

.797	.837	.905	.935	.973	1.067	1.082	1.183	1.213	1.265
1.393	1.438	1.547	1.646	1.701	1.822	1.874	1.962	2.113	2.164
2.337	2.455	2.556	2.705	2.871	3.063	3.307	3.518	3.806	4.043
4.301	4.628	4.927	5.281	5.556	5.931	6.335	6.716	7.121	7.578
8.024	8.513	8.968	9.512	10.061	10.602	11.172	11.798	12.398	13.103
13.802	14.558	15.351	16.152	17.031	17.939	18.907	19.929	21.041	22.136
23.323	24.467	25.925	26.679	27.440	28.132	28.673	29.110	29.437	29.669
29.847	29.980	30.058	30.108	30.148	30.162	30.188	30.185	30.202	30.193
30.195	30.214	30.192	30.191	30.190	30.186	30.189	30.181	30.179	30.170

AUTOCAP LOT J. P.A. FIRING NO. 1

.40	.40	.41	.42	.42	.43	.44	.44	.44	.45	.45
.47	.47	.48	.49	.50	.50	.51	.52	.53	.54	.55
.55	.57	.59	.60	.62	.63	.64	.67	.69	.71	.73
.77	.79	.82	.85	.89	.92	.96	.99	1.04	1.07	1.11
1.16	1.20	1.25	1.29	1.33	1.39	1.43	1.47	1.53	1.58	1.63
1.67	1.73	1.79	1.84	1.89	1.95	2.01	2.08	2.14	2.21	2.27
2.33	2.40	2.49	2.57	2.65	2.73	2.82	2.92	3.03	3.13	3.24
3.36	3.49	3.61	3.74	3.87	4.00	4.14	4.28	4.41	4.56	4.71
4.85	5.01	5.16	5.30	5.47	5.63	5.80	5.97	6.13	6.31	6.49
6.66	6.84	7.04	7.22	7.40	7.58	7.76	7.93	8.14	8.34	8.55
8.77	9.00	9.25	9.49	9.77	10.04	10.33	10.62	10.89	11.17	11.47
11.78	12.07	12.38	12.70	13.01	13.32	13.56	13.98	14.32	14.67	15.03
15.40	15.78	16.17	16.58	16.99	17.42	17.87	18.32	18.79	19.28	19.77
20.27	20.82	21.36	21.91	22.46	23.01	23.59	24.18	24.79	25.37	25.96
26.53	27.10	27.66	28.16	28.69	29.14	29.56	29.94	30.27	30.59	30.84
31.05	31.25	31.41	31.53	31.66	31.75	31.83	31.89	31.94	31.98	32.00

AUTOCAP LOT J. P.A. FIRING NO. 2

.39	.40	.40	.40	.41	.42	.42	.41	.42	.42	.42
.43	.43	.44	.44	.45	.46	.46	.47	.47	.47	.48
.48	.49	.50	.50	.51	.51	.53	.53	.54	.55	.56
.57	.58	.59	.60	.61	.62	.62	.64	.65	.66	.68
.70	.71	.73	.76	.77	.79	.82	.84	.87	.89	.92
.95	.98	1.02	1.05	1.08	1.12	1.15	1.20	1.24	1.28	1.33
1.38	1.44	1.47	1.53	1.59	1.64	1.70	1.75	1.81	1.86	1.92
1.98	2.04	2.11	2.17	2.24	2.30	2.38	2.46	2.54	2.62	2.71
2.82	2.92	3.03	3.14	3.26	3.38	3.51	3.63	3.76	3.90	4.02
4.17	4.30	4.43	4.58	4.73	4.87	5.02	5.16	5.31	5.48	5.62
5.80	5.97	6.13	6.31	6.48	6.66	6.84	7.02	7.22	7.40	7.57
7.74	7.93	8.12	8.32	8.54	8.75	8.98	9.21	9.44	9.68	9.92
10.18	10.42	10.66	10.93	11.17	11.46	11.74	12.02	12.30	12.62	12.91
13.23	13.56	13.89	14.22	14.56	14.92	15.27	15.65	16.04	16.45	16.86
17.27	17.70	18.12	18.59	19.06	19.59	20.08	20.61	21.13	21.68	22.23
22.79	23.36	23.95	24.53	25.12	25.70	26.25	26.83	27.34	27.89	28.36
28.82	29.22	29.61	29.94	30.23	30.49	30.73	30.93	31.09	31.24	31.37
31.47	31.55	31.62	31.69	31.74	31.78	31.81	31.83	31.85	31.86	31.87
31.87	31.87	31.87	31.88	31.88	31.88	31.88	31.88	31.89	31.89	31.89

AUTOCAP LOT J. P.A. FIRING NO. 3

.40	.40	.40	.40	.40	.42	.42	.42	.43	.43	.44
.45	.45	.45	.46	.47	.47	.48	.48	.49	.49	.50
.51	.52	.53	.54	.54	.55	.56	.56	.59	.59	.61
.62	.62	.62	.63	.65	.66	.68	.69	.70	.73	.75
.76	.78	.80	.81	.84	.86	.89	.91	.93	.96	.98
1.01	1.04	1.05	1.08	1.11	1.14	1.18	1.21	1.25	1.28	1.32
1.35	1.39	1.44	1.47	1.52	1.56	1.61	1.65	1.70	1.76	1.81
1.86	1.91	1.96	2.02	2.07	2.14	2.20	2.26	2.31	2.39	2.45
2.53	2.60	2.69	2.76	2.85	2.93	3.01	3.13	3.23	3.35	3.47
3.60	3.72	3.86	3.98	4.13	4.27	4.40	4.56	4.71	4.85	5.01
5.16	5.31	5.48	5.63	5.80	5.99	6.15	6.33	6.50	6.68	6.87
7.04	7.24	7.41	7.59	7.76	7.96	8.13	8.35	8.56	8.78	8.99
9.23	9.46	9.71	9.95	10.2	10.45	10.70	10.96	11.21	11.47	11.75
12.03	12.32	12.63	12.93	13.24	13.57	13.9	14.23	14.57	14.91	15.28
15.66	16.03	16.44	16.85	17.27	17.71	18.13	18.60	19.07	19.58	20.09
20.60	21.14	21.67	22.20	22.76	23.33	23.90	24.46	25.05	25.62	26.17
26.71	27.26	27.74	28.24	28.66	29.08	29.47	29.81	30.11	30.37	30.60
30.79	30.97	31.10	31.22	31.32	31.40	31.46	31.52	31.53	31.54	31.55

AUTOCAP LOT L. P.A. FIRING NO. 1

.46	.47	.47	.49	.49	.50	.51	.52	.53	.54	.55
.56	.57	.58	.60	.61	.62	.63	.65	.66	.68	.69
.71	.72	.74	.75	.77	.80	.81	.83	.86	.88	.89
.91	.94	.95	.97	1.00	1.03	1.04	1.06	1.09	1.12	1.14
1.17	1.21	1.23	1.26	1.30	1.33	1.37	1.40	1.45	1.48	1.51
1.56	1.61	1.65	1.70	1.76	1.80	1.85	1.89	1.94	1.98	2.04
2.08	2.13	2.18	2.22	2.28	2.32	2.38	2.43	2.49	2.55	2.61
2.67	2.7	.79	2.86	2.95	3.02	3.10	3.19	3.28	3.38	3.48
3.59	3.(	.80	3.93	4.04	4.17	4.30	4.42	4.56	4.70	4.83
4.98	5.1	.28	5.44	5.61	5.76	5.92	6.10	6.27	6.46	6.64
6.82	7.0	.21	7.40	7.58	7.75	7.95	8.14	8.36	8.58	8.80
9.03	9.2	50	9.75	10.00	10.25	10.52	10.78	11.04	11.30	11.59
11.87	12.17	47	12.79	13.11	13.44	13.77	14.12	14.47	14.82	15.20
15.57	15.97	.37	16.78	17.19	17.63	18.10	18.57	19.04	19.55	20.10
20.64	21.22	.78	22.36	22.99	23.61	24.24	24.86	25.45	26.03	26.57
27.11	27.58	.07	28.52	28.96	29.36	29.69	30.02	30.30	30.56	30.78
30.95	31.12	.26	31.37	31.46	31.53	31.57	31.60	31.64	31.67	31.68

AUTOCAP LOT L. P.A. FIRING NO. 2

.44	.44	.45	.45	.47	.47	.47	.48	.48	.49	.50
.51	.5	.52	.53	.54	.55	.55	.56	.58	.58	.59
.60	.6	.61	.62	.63	.64	.64	.67	.67	.68	.70
.71	.7	.73	.76	.77	.79	.81	.83	.85	.87	.88
.91	.9	.96	.97	.99	1.02	1.04	1.06	1.08	1.11	1.13
1.16	1.1	.21	1.24	1.27	1.30	1.33	1.36	1.39	1.43	1.45
1.47	1.52	1.54	1.58	1.62	1.66	1.70	1.73	1.77	1.82	1.85
1.88	1.93	1.97	2.00	2.04	2.09	2.13	2.17	2.22	2.27	2.31
2.35	2.40	2.45	2.50	2.55	2.60	2.65	2.71	2.76	2.83	2.88
2.94	3.01	3.08	3.15	3.22	3.30	3.39	3.48	3.58	3.67	3.79
3.90	4.01	4.14	4.27	4.39	4.52	4.66	4.79	5.00	5.09	5.22
5.38	5.54	5.71	5.87	6.04	6.21	6.40	6.58	6.76	6.94	7.16
7.33	7.52	7.71	7.92	8.12	8.32	8.53	8.74	8.98	9.21	9.46
9.72	9.97	10.22	10.49	10.76	11.03	11.32	11.61	11.89	12.18	12.47
12.78	13.10	13.42	13.74	14.08	14.42	14.79	15.15	15.51	15.89	16.28
16.67	17.10	17.51	17.96	18.42	18.89	19.36	19.87	20.38	20.91	21.40
21.98	22.53	23.12	23.70	24.29	24.87	25.47	26.04	26.57	27.10	27.61
28.07	28.47	28.88	29.23	29.55	29.82	30.07	30.29	30.48	30.64	30.79
30.92	31.03	31.10	31.19	31.25	31.29	31.3	31.35	31.38	31.39	31.40
31.40	31.41	31.42	31.43	31.43	31.43	31.43	31.43	31.44	31.44	31.44

AUTOCAP LOT L. P.A. FIRING NO. 3

.44	.44	.44	.45	.46	.47	.47	.48	.49	.49	.49
.50	.51	.51	.53	.54	.55	.55	.56	.56	.58	.59
.60	.61	.62	.62	.63	.64	.66	.68	.69	.70	.72
.73	.75	.77	.79	.81	.82	.85	.87	.89	.91	.94
.96	.98	1.02	1.04	1.05	1.09	1.12	1.15	1.17	1.21	1.24
1.26	1.30	1.33	1.38	1.41	1.45	1.47	1.51	1.55	1.59	1.63
1.67	1.70	1.75	1.79	1.83	1.87	1.91	1.95	1.99	2.04	2.09
2.13	2.17	2.23	2.28	2.32	2.37	2.43	2.49	2.54	2.61	2.67
2.73	2.79	2.86	2.94	3.02	3.10	3.18	3.27	3.36	3.46	3.57
3.67	3.79	3.90	4.01	4.14	4.27	4.40	4.53	4.66	4.80	4.95
5.10	5.24	5.40	5.56	5.73	5.90	6.07	6.25	6.44	6.62	6.81
7.00	7.19	7.37	7.56	7.75	7.96	8.17	8.39	8.61	8.84	9.07
9.31	9.56	9.81	10.07	10.32	10.60	10.87	11.14	11.42	11.73	12.02
12.31	12.63	12.94	13.28	13.63	13.98	14.35	14.73	15.11	15.52	15.91
16.32	16.73	17.16	17.58	18.02	18.49	18.96	19.42	19.93	20.46	20.99
21.53	22.10	22.67	23.24	23.84	24.42	25.01	25.62	26.22	26.77	27.31
27.80	28.29	28.72	29.09	29.46	29.78	30.05	30.28	30.51	30.69	30.87
31.01	31.12	31.24	31.33	31.39	31.44	31.48	31.52	31.53	31.55	31.55

AUTOCAP LOT R. P.A. FIRING NO. 1

.36	.36	.37	.38	.39	.40	.41	.42	.43	.44	.45
.46	.46	.48	.49	.51	.52	.53	.55	.56	.57	.60
.61	.62	.64	.66	.69	.71	.73	.75	.78	.80	.84
.86	.89	.92	.96	.99	1.03	1.05	1.09	1.14	1.17	1.21
1.26	1.30	1.35	1.39	1.44	1.47	1.52	1.58	1.63	1.69	1.74
1.79	1.85	1.89	1.95	2.01	2.07	2.14	2.20	2.28	2.33	2.40
2.48	2.55	2.64	2.71	2.80	2.89	2.99	3.09	3.19	3.31	3.42
3.55	3.69	3.83	3.96	4.11	4.27	4.43	4.58	4.75	4.92	5.08
5.25	5.44	5.62	5.81	6.01	6.21	6.43	6.63	6.84	7.07	7.29
7.54	7.77	8.03	8.28	8.54	8.81	9.10	9.38	9.69	9.98	10.29
10.62	10.95	11.28	11.63	11.98	12.36	12.73	13.13	13.54	13.95	14.37
14.82	15.27	15.74	16.22	16.72	17.23	17.74	18.29	18.85	19.41	20.01
20.61	21.23	21.89	22.55	23.22	23.91	24.59	25.29	25.96	26.59	27.23
27.79	28.34	28.81	29.24	29.61	29.94	30.21	30.45	30.66	30.82	30.97
31.08	31.19	31.26	31.32	31.37	31.41	31.43	31.44	31.45	31.46	31.46
31.47	31.47	31.47	31.47	31.48	31.48	31.48	31.47	31.48	31.48	31.48

AUTOCAP LOT R. P.A. FIRING NO. 2

.37	.38	.37	.39	.39	.40	.41	.42	.43	.44	.45
.47	.47	.48	.49	.51	.52	.53	.55	.57	.58	.60
.62	.63	.65	.67	.70	.72	.75	.77	.80	.83	.85
.88	.92	.95	.98	1.02	1.05	1.08	1.13	1.17	1.21	1.26
1.30	1.35	1.39	1.44	1.48	1.53	1.58	1.64	1.70	1.75	1.81
1.87	1.92	1.98	2.05	2.11	2.19	2.25	2.32	2.39	2.47	2.55
2.64	2.72	2.82	2.91	3.02	3.13	3.24	3.36	3.50	3.63	3.77
3.91	4.06	4.21	4.37	4.54	4.71	4.88	5.06	5.23	5.42	5.61
5.80	6.01	6.21	6.43	6.64	6.85	7.07	7.30	7.55	7.79	8.05
8.30	8.57	8.85	9.14	9.43	9.74	10.05	10.37	10.69	11.04	11.37
11.73	12.09	12.47	12.87	13.26	13.68	14.10	14.55	15.00	15.45	15.94
16.43	16.93	17.44	18.00	18.55	19.12	19.71	20.33	20.96	21.62	22.29
22.97	23.67	24.37	25.08	25.78	26.46	27.13	27.75	28.30	28.85	29.28
29.71	30.09	30.39	30.66	30.89	31.08	31.25	31.38	31.48	31.57	31.64

AUTOCAP LOT R. P.A. FIRING NO. 3

.34	.35	.37	.38	.38	.41	.41	.42	.44	.46	.47
.49	.51	.53	.54	.56	.59	.61	.62	.65	.67	.70
.73	.75	.78	.81	.84	.88	.90	.94	.97	1.02	1.04
1.08	1.13	1.17	1.22	1.25	1.31	1.35	1.40	1.45	1.49	1.55
1.59	1.64	1.70	1.76	1.81	1.87	1.93	1.99	2.06	2.13	2.20
2.27	2.34	2.43	2.52	2.61	2.71	2.81	2.93	3.06	3.19	3.32
3.46	3.59	3.74	3.90	4.04	4.20	4.36	4.52	4.68	4.84	5.02
5.20	5.38	5.57	5.76	5.96	6.15	6.36	6.56	6.80	7.01	7.26
7.49	7.73	7.99	8.25	8.52	8.79	9.07	9.37	9.67	9.98	10.30
10.62	10.96	11.31	11.66	12.03	12.40	12.79	13.20	13.61	14.02	14.47
14.92	15.39	15.88	16.38	16.87	17.38	17.93	18.48	19.06	19.65	20.26
20.90	21.52	22.19	22.85	23.54	24.24	24.92	25.59	26.25	26.86	27.42
27.97	28.44	28.84	29.24	29.57	29.84	30.10	30.30	30.49	30.62	30.75
30.86	30.95	31.01	31.06	31.10	31.13	31.15	31.17	31.19	31.20	31.20
31.21	31.22	31.22	31.22	31.23	31.24	31.23	31.23	31.23	31.23	31.23
31.23	31.23	31.24	31.24	31.23	31.24	31.24	31.23	31.23	31.24	31.24

AUTOCAP LOT S. P.A. FIRING NO. 1

.39	.40	.41	.41	.43	.44	.45	.45	.46	.47	.48
.49	.51	.52	.53	.55	.56	.58	.59	.61	.62	.63
.66	.67	.69	.71	.74	.77	.78	.81	.83	.86	.89
.92	.95	.98	1.01	1.04	1.08	1.10	1.14	1.17	1.22	1.25
1.29	1.34	1.38	1.43	1.46	1.51	1.56	1.60	1.65	1.71	1.76
1.80	1.86	1.90	1.95	2.01	2.06	2.12	2.19	2.25	2.31	2.38
2.44	2.51	2.59	2.67	2.73	2.82	2.91	3.00	3.10	3.19	3.30
3.41	3.54	3.66	3.79	3.92	4.05	4.20	4.35	4.51	4.67	4.83
5.00	5.17	5.35	5.52	5.71	5.89	6.09	6.29	6.49	6.69	6.89
7.12	7.33	7.55	7.78	8.02	8.25	8.49	8.74	8.99	9.25	9.51
9.79	10.07	10.35	10.63	10.93	11.23	11.53	11.87	12.20	12.53	12.88
13.23	13.61	13.98	14.37	14.76	15.17	15.59	16.02	16.46	16.90	17.35
17.82	18.32	18.82	19.31	19.83	20.36	20.90	21.44	21.96	22.53	23.10
23.62	24.15	24.77	25.32	25.85	26.38	26.85	27.33	27.77	28.17	28.54
28.90	29.18	29.47	29.72	29.93	30.12	30.27	30.42	30.54	30.63	30.72
30.79	30.85	30.90	30.94	30.98	31.00	31.02	31.04	31.04	31.05	31.06
31.07	31.07	31.07	31.08	31.08	31.07	31.08	31.08	31.08	31.08	31.08

AUTOCAP LOT S. P.A. FIRING NO. 2

.37	.37	.38	.38	.39	.40	.40	.41	.41	.43	.44
.45	.45	.46	.47	.48	.49	.50	.51	.52	.53	.54
.55	.57	.58	.59	.61	.62	.63	.64	.66	.68	.69
.71	.73	.75	.78	.80	.83	.85	.88	.90	.94	.96
.99	1.03	1.05	1.08	1.11	1.15	1.19	1.23	1.27	1.31	1.35
1.39	1.44	1.47	1.52	1.56	1.61	1.66	1.71	1.76	1.81	1.87
1.91	1.97	2.02	2.08	2.14	2.20	2.26	2.32	2.38	2.45	2.52
2.59	2.67	2.73	2.80	2.89	2.98	3.07	3.16	3.27	3.37	3.49
3.61	3.73	3.86	4.00	4.14	4.29	4.44	4.60	4.78	4.93	5.11
5.28	5.46	5.65	5.84	6.04	6.24	6.44	6.65	6.85	7.06	7.29
7.51	7.72	7.96	8.20	8.45	8.69	8.94	9.20	9.46	9.74	9.99
10.28	10.58	10.86	11.16	11.46	11.78	12.10	12.43	12.78	13.12	13.48
13.85	14.23	14.61	15.01	15.42	15.84	16.27	16.71	17.16	17.61	18.08
18.56	19.05	19.58	20.10	20.62	21.16	21.70	22.26	22.78	23.34	23.90
24.44	24.98	25.50	26.01	26.50	26.94	27.39	27.78	28.15	28.50	28.79
29.05	29.27	29.49	29.68	29.82	29.97	30.08	30.19	30.25	30.33	30.38
30.43	30.47	30.49	30.52	30.54	30.55	30.57	30.57	30.58	30.58	30.58

AUTOCAP LOT S. P.A. FIRING NO. 3

.36	.37	.38	.38	.39	.41	.41	.42	.43	.44	.46
.46	.47	.49	.50	.51	.53	.54	.56	.57	.59	.61
.62	.63	.65	.67	.69	.71	.74	.76	.78	.81	.83
.86	.89	.93	.95	.98	1.02	1.04	1.08	1.11	1.15	1.19
1.23	1.27	1.31	1.35	1.39	1.43	1.47	1.52	1.58	1.63	1.67
1.73	1.78	1.84	1.88	1.94	2.00	2.06	2.13	2.19	2.26	2.33
2.41	2.49	2.59	2.68	2.76	2.88	2.99	3.11	3.23	3.35	3.48
3.61	3.74	3.88	4.01	4.16	4.32	4.46	4.63	4.79	4.95	5.11
5.26	5.44	5.62	5.79	5.97	6.15	6.34	6.51	6.71	6.92	7.13
7.33	7.57	7.78	8.01	8.25	8.49	8.73	8.99	9.25	9.51	9.79
10.06	10.35	10.64	10.93	11.24	11.55	11.87	12.22	12.57	12.91	13.28
13.64	14.03	14.42	14.82	15.22	15.67	16.08	16.54	17.00	17.45	17.94
18.42	18.90	19.44	19.95	20.50	21.04	21.59	22.13	22.69	23.23	23.78
24.33	24.83	25.38	25.88	26.36	26.79	27.21	27.59	27.93	28.24	28.52
28.76	28.96	29.17	29.34	29.49	29.60	29.72	29.80	29.88	29.94	29.99
30.04	30.08	30.11	30.14	30.16	30.17	30.18	30.20	30.20	30.21	30.21
30.21	30.22	30.22	30.23	30.23	30.23	30.23	30.23	30.23	30.23	30.23

AUTOCAP LOT V. P.A. FIRING NO. 1

.37	.37	.38	.38	.40	.41	.41	.43	.43	.44	.46
.46	.47	.49	.50	.51	.52	.54	.56	.57	.59	.61
.62	.63	.66	.69	.70	.72	.76	.78	.81	.84	.87
.90	.94	.97	1.01	1.04	1.07	1.11	1.16	1.20	1.24	1.28
1.33	1.38	1.43	1.47	1.52	1.57	1.63	1.69	1.75	1.80	1.86
1.91	1.97	2.03	2.10	2.16	2.23	2.29	2.37	2.45	2.53	2.61
2.70	2.78	2.90	3.00	3.12	3.25	3.39	3.52	3.67	3.82	3.97
4.13	4.30	4.46	4.62	4.80	4.97	5.17	5.34	5.54	5.73	5.93
6.13	6.34	6.55	6.77	6.99	7.23	7.46	7.71	7.96	8.21	8.48
8.75	9.02	9.31	9.59	9.88	10.20	10.50	10.82	11.14	11.47	11.82
12.16	12.53	12.90	13.29	13.69	14.09	14.50	14.93	15.38	15.83	16.30
16.79	17.28	17.77	18.29	18.84	19.38	19.97	20.56	21.16	21.80	22.43
23.06	23.71	24.37	25.01	25.62	26.22	26.75	27.28	27.74	28.17	28.54
28.87	29.15	29.40	29.62	29.80	29.97	30.10	30.21	30.30	30.38	30.44
30.49	30.52	30.54	30.56	30.57	30.57	30.57	30.57	30.58	30.58	30.59

AUTOCAP LOT V. P.A. FIRING NO. 2

.37	.37	.38	.38	.39	.39	.40	.40	.41	.42	.42
.43	.43	.44	.45	.45	.47	.48	.48	.49	.50	.52
.53	.53	.55	.56	.58	.59	.61	.62	.62	.65	.66
.68	.70	.73	.74	.76	.79	.82	.84	.87	.90	.93
.96	.99	1.03	1.05	1.07	1.11	1.15	1.18	1.23	1.28	1.32
1.37	1.41	1.46	1.49	1.54	1.59	1.65	1.70	1.75	1.81	1.87
1.92	1.98	2.04	2.11	2.17	2.24	2.30	2.38	2.45	2.53	2.61
2.69	2.78	2.86	2.97	3.08	3.19	3.31	3.44	3.58	3.73	3.88
4.03	4.20	4.37	4.53	4.72	4.89	5.08	5.27	5.46	5.66	5.87
6.07	6.30	6.51	6.74	6.96	7.20	7.44	7.70	7.95	8.21	8.48
8.75	9.03	9.31	9.61	9.91	10.21	10.52	10.85	11.18	11.49	11.85
12.20	12.55	12.93	13.32	13.72	14.11	14.53	14.96	15.40	15.86	16.32
16.80	17.28	17.78	18.29	18.84	19.38	19.95	20.52	21.12	21.75	22.38
23.02	23.60	24.19	24.93	25.54	26.12	26.68	27.16	27.63	28.04	28.40
28.69	28.98	29.20	29.42	29.60	29.74	29.86	29.96	30.05	30.11	30.16

AUTOCAP LOT V. P.A. FIRING NO. 3

.36	.36	.37	.37	.39	.40	.41	.42	.44	.45	.46
.48	.49	.51	.52	.55	.57	.58	.60	.62	.64	.66
.69	.71	.73	.77	.80	.84	.86	.90	.93	.98	1.01
1.04	1.08	1.12	1.17	1.20	1.25	1.30	1.35	1.40	1.45	1.49
1.55	1.60	1.66	1.71	1.77	1.82	1.88	1.95	2.01	2.09	2.15
2.22	.29	2.37	2.47	2.56	2.65	2.75	2.86	2.98	3.11	3.23
3.37	3.51	3.65	3.80	3.95	4.10	4.25	4.42	4.59	4.76	4.93
5.11	5.29	5.48	5.67	5.87	6.07	6.28	6.49	6.70	6.92	7.15
7.38	7.63	7.87	8.13	8.39	8.65	8.94	9.21	9.48	9.79	10.09
10.40	10.72	11.04	11.36	11.71	12.06	12.43	12.80	13.18	13.58	13.99
14.40	14.83	15.26	15.73	16.20	16.67	17.17	17.68	18.19	18.74	19.31
19.87	20.46	21.08	21.67	22.29	22.96	23.58	24.21	24.83	25.42	25.97
26.47	26.94	27.35	27.73	28.07	28.36	28.60	28.83	29.01	29.19	29.33
29.44	29.54	29.62	29.69	29.75	29.78	29.80	29.82	29.83	29.85	29.85

AUTOCAP LOT W. P.A. FIRING NO. 1

.37	.37	.38	.38	.39	.40	.41	.42	.42	.43	.44
.45	.46	.47	.48	.49	.51	.51	.53	.54	.55	.57
.58	.60	.61	.62	.63	.66	.67	.69	.71	.73	.76
.78	.81	.83	.85	.89	.91	.94	.97	1.01	1.04	1.07
1.10	1.14	1.17	1.21	1.26	1.29	1.33	1.37	1.42	1.46	1.50
1.54	1.59	1.64	1.69	1.74	1.79	1.84	1.88	1.94	1.99	2.05
2.10	2.16	2.22	2.28	2.34	2.40	2.48	2.54	2.61	2.69	2.76
2.84	2.94	3.03	3.12	3.23	3.35	3.47	3.59	3.73	3.87	4.00
4.15	4.30	4.44	4.61	4.77	4.93	5.09	5.25	5.42	5.60	5.77
5.95	6.13	6.32	6.50	6.70	6.89	7.09	7.29	7.51	7.71	7.94
8.15	8.38	8.61	8.84	9.07	9.31	9.55	9.79	10.06	10.30	10.58
10.85	11.11	11.39	11.67	11.96	12.26	12.56	12.87	13.18	13.51	13.84
14.17	14.52	14.89	15.25	15.62	16.01	16.40	16.81	17.22	17.64	18.08
18.53	18.97	19.44	19.93	20.42	20.92	21.44	21.96	22.48	23.01	23.54
24.07	24.60	25.10	25.58	26.04	26.46	26.85	27.20	27.52	27.80	28.08
28.30	28.51	28.68	28.86	29.00	29.12	29.24	29.33	29.40	29.48	29.54
29.58	29.63	29.65	29.67	29.69	29.69	29.70	29.70	29.71	29.71	29.71

AUTOCAP LOT W. P.A. FIRING NO. 2

.35	.36	.37	.38	.40	.40	.43	.44	.45	.47	.49
.50	.52	.55	.56	.58	.61	.62	.65	.67	.70	.73
.76	.79	.82	.85	.89	.92	.97	1.00	1.03	1.06	1.10
1.14	1.18	1.23	1.27	1.31	1.36	1.41	1.45	1.49	1.54	1.59
1.63	1.69	1.74	1.79	1.85	1.89	1.95	2.00	2.06	2.12	2.19
2.25	2.31	2.38	2.45	2.53	2.62	2.70	2.78	2.88	2.99	3.10
3.20	3.32	3.46	3.59	3.73	3.87	4.00	4.15	4.32	4.47	4.63
4.79	4.96	5.12	5.28	5.47	5.64	5.83	6.02	6.21	6.39	6.60
6.80	6.99	7.20	7.40	7.62	7.84	8.07	8.29	8.52	8.75	8.99
9.24	9.48	9.73	9.98	10.24	10.51	10.77	11.05	11.31	11.61	11.89
12.21	12.52	12.82	13.14	13.48	13.81	14.15	14.51	14.87	15.24	15.61
16.00	16.39	16.82	17.23	17.64	18.09	18.54	19.00	19.47	19.97	20.45
20.98	21.50	22.01	22.54	23.07	23.59	24.12	24.63	25.12	25.57	26.00
26.39	26.74	27.09	27.38	27.66	27.89	28.11	28.29	28.47	28.60	28.73
28.86	28.96	29.04	29.11	29.17	29.21	29.25	29 29	29.32	29.33	29.35
29.36	29.36	29.36	29.37	29.37	29.37	29.37	29.37	29.37	29.37	29.37

AUTOCAP LOT W. P.A. FIRING NO. 3

.34	.35	.36	.38	.39	.41	.41	.42	.44	.46	.48
.49	.51	.52	.54	.56	.57	.60	.62	.64	.66	.68
.71	.73	.76	.79	.82	.85	.87	.91	.94	.97	1.00
1.06	1.06	1.10	1.14	1.18	1.22	1.26	1.30	1.35	1.39	1.43
1.48	1.52	1.57	1.62	1.66	1.72	1.77	1.82	1.87	1.92	1.98
2.05	2.11	2.17	2.24	2.30	2.37	2.45	2.54	2.62	2.71	2.79
2.89	3.01	3.12	3.23	3.36	3.49	3.63	3.76	3.90	4.03	4.18
4.32	4.47	4.63	4.79	4.94	5.11	5.26	5.44	5.61	5.79	5.9
6.15	6.34	6.53	6.72	6.89	7.12	7.32	7.52	7.74	7.96	8.1
8.41	8.64	8.88	9.12	9.36	9.59	9.84	10.10	10.36	10.63	10.9
11.17	11.46	11.74	12.04	12.34	12.66	12.97	13.30	13.63	13.96	14.3
14.69	15.05	15.41	15.80	16.19	16.61	17.03	17.44	17.87	18.33	18.80
19.28	19.75	20.25	20.76	21.27	21.82	22.32	22.85	23.38	23.89	24.39
24.86	25.33	25.76	26.13	26.49	26.81	27.10	27.36	27.59	27.79	27.99
28.14	28.29	28.42	28.52	28.62	28.70	28.78	28.84	28.88	28.92	28.95
28.97	28.98	29.00	29.00	29.01	29.01	29.02	29.02	29.01	29.02	29.02

AUTOCAP LOT P. P.A. FIRING NO. 1

.36	.36	.37	.38	.39	.40	.41	.41	.42	.43	.43
.44	.45	.47	.48	.48	.50	.52	.52	.54	.55	.57
.58	.60	.61	.62	.63	.65	.68	.69	.71	.74	.76
.78	.80	.83	.85	.87	.90	.93	.96	.99	1.02	1.04
1.07	1.10	1.13	1.16	1.20	1.23	1.27	1.30	1.34	1.38	1.41
1.45	1.49	1.52	1.56	1.60	1.65	1.69	1.73	1.78	1.83	1.87
1.92	1.97	2.02	2.07	2.13	2.19	2.25	2.31	2.38	2.44	2.52
2.60	2.68	2.76	2.84	2.93	3.03	3.12	3.22	3.32	3.42	3.52
3.61	3.71	3.82	3.94	4.04	4.15	4.26	4.37	4.49	4.61	4.72
4.84	4.96	5.08	5.21	5.33	5.47	5.61	5.74	5.88	6.03	6.17
6.32	6.46	6.62	6.78	6.93	7.11	7.29	7.45	7.63	7.81	8.00
8.18	8.38	8.58	8.78	8.98	9.18	9.40	9.62	9.84	10.07	10.30
10.54	10.78	11.02	11.26	11.52	11.78	12.03	12.30	12.58	12.87	13.15
13.44	13.74	14.05	14.36	14.67	15.00	15.33	15.66	16.02	16.38	16.72
17.11	17.46	17.85	18.24	18.65	19.06	19.49	19.92	20.35	20.82	21.28
21.76	22.23	22.70	23.20	23.69	24.20	24.71	25.20	25.70	26.19	26.65
27.11	27.54	27.93	28.32	28.65	28.95	29.23	29.49	29.72	29.91	30.09
30.25	30.38	30.51	30.61	30.70	30.78	30.85	30.90	30.96	30.99	31.03
31.04	31.06	31.08	31.09	31.09	31.09	31.10	31.11	31.10	31.10	31.11

AUTOCAP LOT P. P.A. FIRING NO. 2

.36	.37	.38	.38	.39	.39	.40	.41	.41	.42	.43
.44	.45	.46	.46	.48	.49	.49	.51	.52	.53	.54
.56	.57	.58	.59	.60	.62	.62	.65	.66	.68	.69
.71	.73	.76	.78	.80	.82	.85	.88	.90	.92	.96
.99	1.02	1.04	1.08	1.11	1.15	1.18	1.22	1.25	1.29	1.32
1.36	1.39	1.43	1.46	1.50	1.54	1.57	1.62	1.66	1.70	1.75
1.79	1.84	1.88	1.92	1.98	2.03	2.08	2.14	2.19	2.25	2.30
2.36	2.44	2.50	2.57	2.65	2.71	2.80	2.88	2.98	3.07	3.16
3.25	3.35	3.44	3.54	3.64	3.75	3.86	3.96	4.06	4.18	4.29
4.40	4.51	4.64	4.76	4.87	4.99	5.13	5.25	5.38	5.52	5.65
5.79	5.93	6.08	6.23	6.37	6.53	6.69	6.85	7.01	7.18	7.35
7.53	7.71	7.90	8.09	8.27	8.47	8.66	8.88	9.08	9.29	9.51
9.73	9.95	10.19	10.41	10.65	10.89	11.13	11.39	11.64	11.90	12.18
12.45	12.72	13.02	13.30	13.58	13.90	14.21	14.52	14.83	15.17	15.50
15.85	16.20	16.55	16.90	17.29	17.67	18.04	18.46	18.86	19.29	19.71
20.15	20.60	21.04	21.51	21.97	22.45	22.94	23.43	23.94	24.44	24.94
25.42	25.93	26.38	26.85	27.29	27.71	28.08	28.43	28.74	29.05	29.32
29.54	29.76	29.93	30.10	30.23	30.36	30.46	30.55	30.63	30.69	30.73
30.80	30.83	30.86	30.88	30.90	30.91	30.92	30.92	30.92	30.92	30.92

AUTOCAP LOT P. P.A. FIRING NO. 3

.36	.36	.37	.39	.40	.41	.42	.43	.45	.46	.47
.49	.50	.52	.53	.56	.57	.59	.60	.62	.65	.66
.69	.71	.73	.76	.79	.81	.84	.87	.89	.93	.95
.98	1.01	1.04	1.07	1.09	1.12	1.16	1.19	1.24	1.26	1.30
1.34	1.38	1.41	1.46	1.49	1.53	1.57	1.62	1.66	1.71	1.75
1.80	1.85	1.88	1.93	1.98	2.04	2.09	2.15	2.22	2.27	2.33
2.40	2.48	2.55	2.63	2.71	2.80	2.86	2.98	3.07	3.15	3.24
3.34	3.43	3.53	3.62	3.72	3.83	3.94	4.04	4.15	4.26	4.37
4.47	4.57	4.70	4.80	4.92	5.05	5.18	5.29	5.42	5.56	5.68
5.82	5.96	6.09	6.24	6.39	6.53	6.68	6.84	6.99	7.15	7.32
7.50	7.67	7.85	8.03	8.20	8.40	8.59	8.78	8.98	9.19	9.39
9.61	9.83	10.04	10.27	10.51	10.74	10.98	11.22	11.47	11.74	11.99
12.26	12.53	12.81	13.09	13.38	13.67	13.98	14.29	14.60	14.92	15.25
15.59	15.93	16.29	16.65	17.00	17.36	17.75	18.14	18.54	18.95	19.37
19.79	20.23	20.66	21.13	21.59	22.07	22.54	23.04	23.53	24.02	24.53
25.04	25.54	26.04	26.51	26.95	27.38	27.80	28.18	28.52	28.85	29.13
29.40	29.65	29.85	30.04	30.20	30.35	30.47	30.59	30.68	30.76	30.84
30.90	30.95	30.99	31.03	31.05	31.07	31.08	31.09	31.11	31.11	31.12

AUTOCAP LOT Q. P.A. FIRING NO. 1

.43	.44	.45	.45	.46	.47	.47	.48	.49	.50	.51
.52	.53	.54	.55	.56	.58	.59	.60	.62	.62	.64
.66	.67	.68	.70	.72	.73	.75	.77	.79	.81	.83
.86	.88	.90	.93	.95	.98	1.00	1.03	1.05	1.08	1.11
1.14	1.16	1.20	1.23	1.26	1.30	1.33	1.36	1.39	1.43	1.46
1.49	1.53	1.57	1.61	1.65	1.69	1.73	1.77	1.82	1.87	1.90
1.94	1.99	2.04	2.09	2.14	2.20	2.26	2.31	2.36	2.43	2.49
2.57	2.64	2.72	2.80	2.87	2.96	3.05	3.12	3.22	3.30	3.40
3.49	3.58	3.67	3.76	3.87	3.95	4.05	4.15	4.25	4.35	4.44
4.55	4.66	4.77	4.87	4.98	5.10	5.21	5.33	5.44	5.56	5.68
5.81	5.94	6.06	6.19	6.33	6.46	6.61	6.74	6.87	7.02	7.18
7.32	7.48	7.63	7.79	7.95	8.12	8.27	8.45	8.62	8.79	8.96
9.15	9.33	9.52	9.71	9.90	10.09	10.28	10.49	10.69	10.91	11.11
11.32	11.53	11.77	11.98	12.22	12.45	12.69	12.92	13.17	13.43	13.68
13.94	14.20	14.47	14.75	15.03	15.30	15.63	15.89	16.20	16.49	16.82
17.13	17.45	17.77	18.11	18.46	18.80	19.16	19.52	19.89	20.28	20.65
21.04	21.46	21.87	22.28	22.69	23.12	23.54	23.97	24.42	24.85	25.28
25.69	26.12	26.52	26.89	27.25	27.61	27.93	28.23	28.50	28.76	28.99
29.20	29.40	29.59	29.75	29.89	30.02	30.14	30.24	30.34	30.42	30.50
30.57	30.62	30.68	30.72	30.75	30.77	30.80	30.82	30.83	30.84	30.85

AUTOCAP LOT Q. P.A. FIRING NO. 2

.46	.47	.49	.50	.52	.53	.54	.56	.58	.60	.61
.63	.65	.67	.69	.71	.73	.76	.79	.81	.84	.86
.89	.92	.94	.98	1.01	1.04	1.07	1.11	1.14	1.19	1.21
1.24	1.29	1.33	1.36	1.40	1.44	1.47	1.51	1.55	1.58	1.63
1.67	1.71	1.75	1.80	1.84	1.88	1.93	1.97	2.02	2.07	2.13
2.18	2.24	2.29	2.35	2.41	2.48	2.55	2.62	2.69	2.76	2.85
2.93	3.02	3.11	3.20	3.29	3.38	3.48	3.56	3.66	3.76	3.86
3.96	4.06	4.16	4.27	4.37	4.47	4.58	4.69	4.79	4.91	5.03
5.14	5.25	5.38	5.50	5.62	5.75	5.89	6.02	6.15	6.29	6.42
6.56	6.70	6.86	7.00	7.16	7.31	7.47	7.64	7.79	7.96	8.12
8.29	8.47	8.64	8.82	9.00	9.19	9.37	9.57	9.76	9.96	10.15
10.36	10.57	10.77	10.97	11.19	11.41	11.63	11.86	12.09	12.32	12.56
12.80	13.04	13.30	13.56	13.82	14.08	14.35	14.63	14.91	15.19	15.48
15.77	16.07	16.38	16.69	16.98	17.31	17.65	17.98	18.32	18.66	19.03
19.39	19.76	20.15	20.54	20.93	21.34	21.75	22.15	22.57	23.00	23.43
23.86	24.29	24.74	25.15	25.58	25.99	26.37	26.75	27.10	27.45	27.77
28.07	28.33	28.58	28.81	29.03	29.23	29.40	29.56	29.72	29.83	29.95
30.06	30.15	30.23	30.30	30.37	30.43	30.47	30.52	30.56	30.59	30.61
30.62	30.63	30.64	30.65	30.66	30.67	30.66	30.67	30.67	30.67	30.67

AUTOCAP LOT Q. P.A. FIRING NO. 3

.44	.45	.46	.46	.48	.49	.50	.52	.53	.54	.56
.57	.58	.60	.62	.62	.64	.66	.68	.70	.72	.74
.76	.78	.80	.83	.85	.88	.91	.93	.95	.97	1.00
1.03	1.05	1.08	1.11	1.14	1.17	1.20	1.24	1.27	1.30	1.33
1.36	1.41	1.43	1.46	1.50	1.54	1.57	1.61	1.65	1.69	1.73
1.77	1.81	1.85	1.88	1.93	1.97	2.02	2.07	2.11	2.16	2.22
2.27	2.32	2.38	2.43	2.50	2.57	2.64	2.71	2.77	2.86	2.94
3.03	3.11	3.19	3.27	3.37	3.47	3.56	3.66	3.75	3.86	3.96
4.06	4.17	4.27	4.37	4.48	4.60	4.71	4.82	4.94	5.05	5.17
5.29	5.41	5.54	5.65	5.79	5.92	6.05	6.19	6.34	6.47	6.62
6.76	6.91	7.07	7.22	7.37	7.54	7.70	7.86	8.03	8.19	8.37
8.54	8.72	8.90	9.08	9.27	9.44	9.65	9.83	10.03	10.22	10.44
10.64	10.85	11.06	11.27	11.47	11.70	11.93	12.16	12.39	12.63	12.87
13.12	13.37	13.62	13.88	14.15	14.41	14.68	14.96	15.24	15.54	15.83
16.12	16.44	16.75	17.06	17.37	17.71	18.04	18.38	18.72	19.07	19.44
19.80	20.19	20.57	20.96	21.35	21.75	22.17	22.57	22.98	23.41	23.82
24.24	24.66	25.07	25.46	25.85	26.22	26.58	26.89	27.22	27.49	27.78
28.02	28.25	28.47	28.65	28.84	28.99	29.13	29.27	29.38	29.49	29.59
29.68	29.75	29.82	29.87	29.93	29.97	30.00	30.04	30.07	30.09	30.10

AUTOCAP LOT T. P.A. FIRING NO. 1

.43	.44	.45	.45	.46	.47	.48	.49	.50	.51	.52
.53	.54	.56	.56	.58	.59	.60	.62	.62	.64	.65
.67	.69	.71	.72	.74	.76	.78	.80	.82	.84	.87
.89	.91	.93	.96	.99	1.01	1.04	1.06	1.09	1.12	1.15
1.18	1.21	1.24	1.28	1.32	1.35	1.38	1.42	1.46	1.49	1.53
1.56	1.60	1.65	1.69	1.73	1.77	1.81	1.86	1.89	1.93	1.98
2.03	2.08	2.13	2.19	2.25	2.29	2.35	2.42	2.48	2.55	2.63
2.71	2.78	2.86	2.95	3.05	3.13	3.23	3.34	3.43	3.53	3.63
3.74	3.84	3.96	4.06	4.17	4.28	4.39	4.51	4.63	4.75	4.86
4.99	5.12	5.24	5.38	5.51	5.64	5.78	5.94	6.07	6.22	6.35
6.50	6.66	6.82	6.97	7.13	7.29	7.46	7.64	7.80	7.99	8.16
8.34	8.53	8.71	8.91	9.10	9.31	9.51	9.71	9.92	10.14	10.35
10.57	10.79	11.02	11.24	11.46	11.71	11.96	12.21	12.47	12.73	13.01
13.27	13.55	13.84	14.12	14.42	14.73	15.02	15.35	15.67	16.00	16.33
16.68	17.03	17.36	17.73	18.11	18.50	18.89	19.28	19.69	20.10	20.53
20.96	21.41	21.86	22.30	22.75	23.22	23.69	24.16	24.63	25.10	25.55
25.99	26.39	26.80	27.13	27.48	27.79	28.09	28.34	28.56	28.79	28.98
29.15	29.30	29.43	29.55	29.66	29.76	29.83	29.90	29.96	30.02	30.05
30.09	30.12	30.14	30.15	30.17	30.17	30.18	30.18	30.18	30.18	30.18

AUTOCAP LOT T. P.A. FIRING NO. 2

.45	.46	.48	.48	.49	.51	.52	.54	.55	.57	.58
.60	.61	.63	.64	.66	.68	.69	.72	.74	.77	.79
.81	.84	.85	.88	.91	.93	.97	.99	1.02	1.04	1.07
1.10	1.13	1.16	1.20	1.23	1.27	1.30	1.33	1.37	1.41	1.45
1.48	1.52	1.55	1.60	1.64	1.68	1.72	1.76	1.81	1.85	1.89
1.94	1.98	2.04	2.09	2.14	2.20	2.26	2.31	2.37	2.44	2.50
2.58	2.65	2.72	2.81	2.89	2.98	3.07	3.16	3.25	3.35	3.45
3.55	3.65	3.75	3.86	3.96	4.07	4.18	4.29	4.40	4.50	4.63
4.74	4.86	4.98	5.11	5.23	5.36	5.49	5.62	5.75	5.90	6.04
6.18	6.32	6.46	6.60	6.76	6.91	7.07	7.23	7.39	7.55	7.73
7.90	8.08	8.25	8.44	8.62	8.80	8.99	9.19	9.38	9.58	9.79
9.99	10.21	10.43	10.63	10.87	11.08	11.30	11.54	11.79	12.04	12.29
12.55	12.80	13.08	13.35	13.62	13.91	14.19	14.48	14.79	15.10	15.41
15.73	16.06	16.41	16.73	17.08	17.43	17.79	18.17	18.54	18.94	19.34
19.74	20.16	20.58	20.99	21.44	21.88	22.33	22.78	23.25	23.71	24.17
24.62	25.07	25.51	25.91	26.32	26.68	27.03	27.35	27.64	27.90	28.15
28.36	28.57	28.75	28.92	29.05	29.18	29.29	29.39	29.47	29.55	29.62
29.68	29.72	29.76	29.79	29.81	29.83	29.84	29.86	29.86	29.86	29.87

AUTOCAP LOT T. P.A. FIRING NO. 3

.44	.45	.47	.48	.48	.49	.51	.52	.54	.55	.57
.59	.60	.61	.63	.64	.66	.68	.70	.72	.74	.77
.79	.81	.84	.87	.89	.92	.94	.97	1.00	1.02	1.04
1.07	1.11	1.13	1.17	1.19	1.23	1.26	1.30	1.33	1.36	1.40
1.44	1.47	1.50	1.54	1.58	1.62	1.66	1.70	1.74	1.79	1.84
1.87	1.90	1.96	2.00	2.06	2.11	2.17	2.22	2.27	2.33	2.39
2.45	2.52	2.59	2.66	2.73	2.81	2.90	2.98	3.05	3.15	3.25
3.34	3.44	3.54	3.65	3.75	3.86	3.97	4.08	4.19	4.31	4.41
4.53	4.65	4.78	4.89	5.02	5.14	5.26	5.39	5.52	5.65	5.79
5.93	6.07	6.22	6.38	6.51	6.67	6.82	6.97	7.13	7.29	7.46
7.64	7.80	7.98	8.15	8.33	8.52	8.70	8.89	9.08	9.27	9.47
9.67	9.87	10.09	10.30	10.51	10.73	10.96	11.16	11.41	11.65	11.88
12.13	12.37	12.63	12.89	13.15	13.43	13.71	13.97	14.29	14.58	14.87
15.19	15.50	15.81	16.14	16.47	16.81	17.16	17.51	17.87	18.23	18.66
19.09	19.39	19.79	20.21	20.63	21.06	21.47	21.93	22.37	22.82	23.27
23.73	24.17	24.62	25.06	25.48	25.89	26.27	26.62	26.96	27.26	27.56
27.83	28.07	28.28	28.47	28.64	28.81	28.95	29.07	29.18	29.29	29.37
29.44	29.51	29.57	29.61	29.66	29.69	29.71	29.74	29.75	29.77	29.78

AUTOCAP LOT U. P.A. FIRING NO. 1

.42	.42	.42	.42	.44	.44	.45	.45	.45	.46	.47
.48	.49	.49	.50	.51	.53	.53	.54	.55	.55	.57
.58	.59	.60	.62	.62	.63	.64	.65	.68	.68	.71
.72	.74	.76	.78	.80	.82	.84	.86	.88	.90	.93
.95	.98	1.01	1.03	1.05	1.07	1.10	1.13	1.16	1.19	1.22
1.25	1.28	1.31	1.34	1.38	1.41	1.44	1.47	1.50	1.54	1.57
1.61	1.65	1.69	1.72	1.76	1.80	1.84	1.87	1.91	1.94	1.98
2.03	2.07	2.12	2.16	2.21	2.26	2.30	2.35	2.40	2.47	2.52
2.58	2.64	2.71	2.78	2.85	2.93	3.02	3.09	3.17	3.27	3.35
3.44	3.53	3.62	3.71	3.81	3.90	3.99	4.09	4.19	4.30	4.39
4.49	4.60	4.70	4.81	4.91	5.03	5.14	5.25	5.36	5.48	5.59
5.70	5.82	5.95	6.06	6.19	6.31	6.44	6.56	6.68	6.81	6.94
7.07	7.21	7.35	7.48	7.62	7.76	7.90	8.06	8.19	8.34	8.50
8.64	8.78	8.94	9.10	9.26	9.42	9.58	9.75	9.91	10.08	10.25
10.42	10.60	10.77	10.96	11.14	11.32	11.50	11.70	11.89	12.10	12.30
12.50	12.71	12.92	13.13	13.35	13.58	13.81	14.04	14.27	14.51	14.76
15.00	15.26	15.51	15.77	16.04	16.32	16.59	16.87	17.16	17.44	17.74
18.05	18.37	18.69	19.00	19.33	19.68	20.01	20.36	20.71	21.08	21.45
21.83	22.20	22.57	22.96	23.35	23.72	24.09	24.47	24.83	25.19	25.53
25.85	26.16	26.46	26.71	26.96	27.18	27.40	27.59	27.76	27.92	28.08

AUTOCAP LOT U. P.A. FIRING NO. 2

.46	.47	.48	.49	.51	.52	.54	.55	.56	.58	.59
.61	.62	.64	.65	.67	.69	.71	.72	.74	.77	.79
.81	.83	.86	.88	.90	.93	.95	.98	1.00	1.03	1.05
1.07	1.11	1.14	1.17	1.19	1.23	1.26	1.29	1.32	1.36	1.38
1.42	1.46	1.48	1.52	1.56	1.59	1.62	1.66	1.70	1.75	1.78
1.81	1.85	1.89	1.94	1.98	2.02	2.07	2.11	2.16	2.22	2.27
2.31	2.37	2.42	2.48	2.54	2.61	2.67	2.73	2.81	2.88	2.96
3.04	3.12	3.20	3.29	3.38	3.47	3.56	3.65	3.76	3.85	3.95
4.04	4.14	4.24	4.35	4.44	4.56	4.66	4.77	4.87	4.98	5.09
5.21	5.32	5.44	5.56	5.67	5.79	5.92	6.04	6.16	6.29	6.42
6.54	6.67	6.80	6.93	7.06	7.20	7.34	7.47	7.63	7.76	7.90
8.06	8.19	8.34	8.49	8.64	8.80	8.96	9.11	9.27	9.43	9.60
9.77	9.93	10.11	10.28	10.46	10.63	10.82	11.01	11.18	11.37	11.56
11.75	11.95	12.16	12.36	12.57	12.78	13.00	13.23	13.45	13.67	13.91
14.14	14.38	14.62	14.87	15.13	15.39	15.65	15.92	16.18	16.46	16.75
17.04	17.31	17.62	17.92	18.23	18.55	18.88	19.21	19.54	19.88	20.22
20.58	20.95	21.30	21.68	22.06	22.42	22.80	23.17	23.55	23.94	24.30
24.65	25.00	25.32	25.65	25.94	26.22	26.47	26.71	26.92	27.13	27.31
27.49	27.65	27.78	27.92	28.04	28.14	28.25	28.33	28.40	28.47	28.54

AUTOCAP LOT U. P.A. FIRING NO. 3

.47	.47	.49	.50	.52	.53	.54	.56	.58	.60	.60
.62	.64	.65	.67	.70	.72	.74	.76	.78	.81	.84
.86	.89	.91	.94	.97	1.00	1.03	1.05	1.07	1.11	1.14
1.17	1.20	1.23	1.26	1.29	1.33	1.36	1.39	1.42	1.46	1.49
1.52	1.57	1.61	1.65	1.68	1.72	1.76	1.80	1.84	1.88	1.92
1.96	2.01	2.06	2.10	2.15	2.21	2.26	2.30	2.36	2.42	2.48
2.55	2.61	2.69	2.75	2.82	2.90	2.97	3.05	3.13	3.21	3.30
3.38	3.48	3.56	3.65	3.74	3.84	3.93	4.02	4.12	4.21	4.31
4.40	4.50	4.61	4.71	4.81	4.91	5.03	5.13	5.23	5.34	5.46
5.57	5.69	5.80	5.92	6.04	6.16	6.29	6.41	6.53	6.65	6.77
6.90	7.03	7.16	7.29	7.43	7.57	7.71	7.84	7.98	8.12	8.27
8.41	8.56	8.71	8.87	9.01	9.17	9.34	9.49	9.66	9.81	9.98
10.16	10.32	10.50	10.67	10.85	11.03	11.21	11.40	11.59	11.78	11.97
12.18	12.37	12.59	12.80	13.02	13.23	13.45	13.68	13.91	14.14	14.37
14.62	14.85	15.11	15.36	15.62	15.89	16.14	16.44	16.71	16.99	17.27
17.55	17.86	18.16	18.48	18.80	19.13	19.46	19.79	20.13	20.49	20.83
21.20	21.57	21.92	22.29	22.67	23.04	23.41	23.78	24.14	24.49	24.83
25.17	25.47	25.76	26.04	26.30	26.53	26.74	26.94	27.13	27.30	27.46
27.61	27.73	27.85	27.97	28.07	28.15	28.23	28.31	28.37	28.44	28.48

AUTOCAP LOT K. P.A. FIRING NO. 1

.44	.44	.45	.45	.45	.45	.46	.45	.45	.45	.44
.43	.44	.44	.44	.45	.45	.46	.47	.47	.49	.50
.51	.53	.55	.56	.58	.60	.62	.62	.64	.66	.67
.68	.69	.70	.72	.72	.74	.75	.76	.77	.79	.80
.81	.83	.84	.85	.87	.89	.91	.92	.94	.95	.97
1.00	1.02	1.04	1.05	1.07	1.10	1.12	1.15	1.18	1.20	1.23
1.25	1.28	1.30	1.33	1.36	1.39	1.43	1.45	1.48	1.51	1.54
1.58	1.61	1.64	1.68	1.72	1.76	1.80	1.84	1.88	1.91	1.95
2.00	2.04	2.09	2.14	2.18	2.24	2.29	2.33	2.39	2.44	2.50
2.56	2.61	2.68	2.72	2.79	2.85	2.92	3.00	3.06	3.14	3.23
3.31	3.40	3.50	3.60	3.72	3.84	3.96	4.07	4.21	4.34	4.47
4.60	4.75	4.88	5.03	5.19	5.34	5.49	5.65	5.81	5.98	6.14
6.31	6.47	6.65	6.83	7.02	7.22	7.41	7.61	7.78	7.96	8.13
8.33	8.54	8.74	8.96	9.19	9.40	9.64	9.87	10.12	10.37	10.62
10.87	11.12	11.40	11.68	11.96	12.25	12.55	12.88	13.20	13.52	13.86
14.21	14.56	14.91	15.28	15.67	16.04	16.46	16.87	17.29	17.72	18.17
18.64	19.12	19.60	20.13	20.63	21.16	21.71	22.26	22.84	23.43	24.01
24.60	25.21	25.81	26.38	26.94	27.51	28.04	28.51	28.96	29.37	29.74
30.05	30.33	30.58	30.79	30.96	31.11	31.23	31.33	31.43	31.48	31.53
31.58	31.62	31.65	31.65	31.66	31.66	31.67	31.66	31.66	31.65	31.65

AUTOCAP LOT K. P.A. FIRING NO. 2

.43	.44	.44	.45	.42	.46	.46	.46	.47	.48	.48
.49	.49	.49	.50	.51	.52	.52	.53	.54	.55	.56
.56	.56	.58	.59	.59	.60	.61	.62	.63	.63	.65
.66	.67	.68	.70	.71	.73	.75	.76	.78	.80	.81
.84	.86	.88	.90	.92	.95	.97	1.00	1.02	1.04	1.07
1.09	1.12	1.15	1.18	1.20	1.24	1.27	1.31	1.34	1.37	1.40
1.44	1.47	1.50	1.54	1.59	1.64	1.68	1.73	1.77	1.83	1.87
1.93	1.99	2.05	2.10	2.16	2.22	2.28	2.33	2.40	2.47	2.54
2.61	2.69	2.75	2.85	2.94	3.03	3.12	3.23	3.34	3.44	3.56
3.68	3.78	3.91	4.04	4.17	4.31	4.44	4.58	4.72	4.85	4.99
5.15	5.30	5.45	5.62	5.78	5.95	6.10	6.28	6.46	6.64	6.82
7.00	7.13	7.33	7.55	7.72	7.90	8.09	8.29	8.51	8.72	8.94
9.17	9.40	9.64	9.89	10.16	10.40	10.65	10.91	11.16	11.44	11.71
12.00	12.29	12.61	12.92	13.25	13.59	13.93	14.27	14.64	15.01	15.40
15.79	16.19	16.61	17.02	17.45	17.91	18.37	18.86	19.35	19.85	20.38
20.91	21.46	22.02	22.61	23.19	23.78	24.40	24.99	25.60	26.18	26.75
27.28	27.79	28.27	28.70	29.07	29.44	29.76	30.03	30.27	30.49	30.67
30.84	30.98	31.10	31.20	31.29	31.37	31.42	31.46	31.50	31.53	31.56

AUTOCAP LOT K. P.A. FIRING NO. 3

.42	.43	.43	.43	.44	.44	.45	.46	.47	.47	.48
.49	.49	.49	.50	.51	.51	.52	.53	.53	.54	.54
.55	.57	.57	.58	.59	.60	.62	.62	.63	.64	.65
.66	.68	.69	.71	.72	.73	.75	.76	.78	.78	.80
.81	.82	.84	.85	.88	.89	.91	.93	.94	.96	.98
1.00	1.02	1.04	1.06	1.08	1.10	1.12	1.15	1.18	1.20	1.23
1.26	1.29	1.32	1.35	1.37	1.40	1.44	1.46	1.49	1.53	1.56
1.60	1.63	1.67	1.71	1.75	1.79	1.83	1.87	1.91	1.95	1.99
2.03	2.08	2.14	2.18	2.23	2.28	2.33	2.38	2.44	2.49	2.56
2.62	2.67	2.74	2.80	2.86	2.94	3.01	3.09	3.16	3.26	3.36
3.46	3.57	3.67	3.79	3.92	4.04	4.17	4.30	4.42	4.56	4.70
4.84	4.99	5.14	5.28	5.44	5.60	5.75	5.92	6.08	6.26	6.42
6.59	6.77	6.94	7.14	7.30	7.47	7.63	7.81	8.00	8.20	8.41
8.63	8.86	9.10	9.34	9.57	9.81	10.05	10.31	10.56	10.83	11.06
11.34	11.61	11.88	12.19	12.49	12.80	13.12	13.46	13.79	14.13	14.47
14.83	15.21	15.60	15.99	16.39	16.81	17.23	17.65	18.10	18.54	18.99
19.46	19.99	20.51	21.05	21.63	22.20	22.78	23.37	23.97	24.57	25.17
25.77	26.36	26.92	27.47	27.98	28.45	28.92	29.33	29.67	30.01	30.30
30.56	30.77	30.94	31.11	31.26	31.38	31.46	31.55	31.61	31.66	31.70

REFERENCE LOT K FOR LOTS(R-S-V-W). P.A. FIRING NO. 1

.36	.38	.38	.39	.39	.40	.41	.41	.42	.43	.44
.45	.46	.47	.48	.49	.50	.51	.52	.54	.55	.57
.58	.60	.61	.62	.63	.65	.67	.69	.71	.73	.75
.78	.80	.82	.84	.87	.90	.92	.96	.98	1.01	1.04
1.07	1.10	1.13	1.17	1.20	1.24	1.27	1.31	1.35	1.38	1.42
1.46	1.49	1.53	1.58	1.62	1.66	1.71	1.76	1.80	1.84	1.88
1.93	1.98	2.03	2.08	2.14	2.19	2.24	2.29	2.35	2.41	2.47
2.54	2.61	2.68	2.74	2.84	2.92	3.01	3.12	3.21	3.32	3.43
3.54	3.66	3.77	3.90	4.01	4.14	4.27	4.40	4.53	4.67	4.80
4.95	5.10	5.24	5.40	5.56	5.72	5.88	6.04	6.22	6.40	6.57
6.75	6.92	7.11	7.30	7.51	7.71	7.91	8.12	8.33	8.55	8.78
8.99	9.25	9.49	9.74	9.98	10.24	10.50	10.77	11.04	11.33	11.62
11.91	12.23	12.54	12.86	13.19	13.54	13.90	14.27	14.64	15.01	15.42
15.83	16.24	16.67	17.10	17.55	18.01	18.49	18.97	19.46	19.99	20.52
21.06	21.63	22.19	22.74	23.35	23.92	24.5	25.15	25.73	26.30	26.85
27.35	27.85	28.29	28.72	29.07	29.41	29.69	29.96	30.19	30.38	30.56
30.69	30.82	30.93	31.01	31.07	31.13	31.18	31.21	31.23	31.25	31.26

REFERENCE LOT K FOR LOTS(R-S-V-W). P.A. FIRING NO. 2

.35	.37	.38	.38	.39	.41	.41	.42	.43	.45	.46
.46	.48	.49	.50	.52	.53	.54	.55	.57	.59	.60
.62	.64	.65	.67	.69	.72	.73	.75	.78	.80	.83
.85	.88	.91	.94	.97	1.00	1.03	1.05	1.09	1.12	1.16
1.19	1.23	1.26	1.30	1.34	1.37	1.41	1.46	1.49	1.53	1.57
1.62	1.66	1.71	1.75	1.80	1.85	1.89	1.94	1.99	2.03	2.08
2.14	2.20	2.26	2.30	2.37	2.44	2.50	2.58	2.66	2.73	2.81
2.91	3.01	3.11	3.20	3.32	3.42	3.54	3.65	3.76	3.88	3.99
4.13	4.25	4.37	4.51	4.65	4.79	4.94	5.09	5.22	5.38	5.53
5.69	5.85	6.02	6.17	6.35	6.53	6.71	6.89	7.07	7.27	7.46
7.67	7.87	8.09	8.30	8.52	8.75	8.97	9.20	9.45	9.69	9.95
10.20	10.47	10.74	11.03	11.29	11.59	11.88	12.19	12.51	12.84	13.16
13.52	13.87	14.22	14.61	14.99	15.38	15.78	16.21	16.63	17.07	17.50
17.97	18.44	18.93	19.41	19.94	20.46	21.00	21.56	22.11	22.69	23.28
23.87	24.45	25.04	25.64	26.20	26.75	27.28	27.73	28.16	28.56	28.93
29.23	29.53	29.79	30.01	30.20	30.35	30.5	30.62	30.73	30.82	30.89
30.94	30.99	31.03	31.05	31.06	31.08	31.09	31.10	31.10	31.11	31.11
31.12	31.12	31.12	31.12	31.12	31.12	31.13	31.13	31.13	31.13	31.14

REFERENCE LOT K FOR LOTS(R-S-V-W). P.A. FIRING NO. 3

.34	.35	.37	.37	.39	.40	.41	.42	.43	.44	.46
.48	.49	.51	.52	.54	.56	.57	.59	.61	.62	.65
.67	.70	.71	.74	.77	.79	.82	.85	.87	.90	.93
.96	.99	1.03	1.05	1.09	1.13	1.16	1.20	1.24	1.28	1.32
1.36	1.39	1.44	1.47	1.51	1.56	1.60	1.65	1.69	1.74	1.80
1.84	1.88	1.94	2.00	2.06	2.12	2.18	2.25	2.31	2.38	2.46
2.54	2.63	2.71	2.80	2.90	3.00	3.10	3.21	3.31	3.42	3.54
3.65	3.76	3.88	4.00	4.13	4.26	4.39	4.53	4.67	4.80	4.95
5.09	5.24	5.40	5.55	5.70	5.87	6.04	6.21	6.37	6.55	6.74
6.92	7.11	7.30	7.51	7.71	7.91	8.12	8.34	8.56	8.79	9.02
9.27	9.50	9.76	10.00	10.26	10.52	10.79	11.06	11.36	11.65	11.95
12.27	12.59	12.92	13.26	13.60	13.96	14.33	14.72	15.08	15.50	15.91
16.34	16.77	17.20	17.65	18.12	18.60	19.09	19.61	20.13	20.65	21.20
21.77	22.31	22.90	23.49	24.07	24.66	25.22	25.79	26.31	26.83	27.30
27.74	28.13	28.53	28.86	29.15	29.41	29.64	29.84	30.03	30.18	30.30
30.41	30.52	30.59	30.65	30.70	30.75	30.78	30.81	30.83	30.85	30.86
30.86	30.88	30.89	30.90	30.90	30.91	30.91	30.91	30.92	30.92	30.92
30.92	30.93	30.93	30.92	30.93	30.93	30.94	30.94	30.93	30.93	30.94

REFERENCE LOT K FOR LOTS(P-Q-T-U). P.A. FIRING NO. 1

.36	.37	.38	.38	.39	.40	.41	.42	.43	.44	.45
.46	.48	.48	.50	.51	.52	.54	.55	.57	.58	.59
.61	.62	.64	.66	.68	.69	.72	.74	.76	.78	.81
.84	.86	.89	.92	.94	.97	1.00	1.03	1.05	1.08	1.12
1.15	1.18	1.22	1.26	1.30	1.33	1.37	1.41	1.45	1.48	1.52
1.57	1.61	1.66	1.70	1.74	1.78	1.83	1.86	1.90	1.96	2.00
2.05	2.10	2.15	2.21	2.27	2.32	2.38	2.44	2.52	2.59	2.67
2.75	2.83	2.92	3.03	3.12	3.21	3.32	3.43	3.54	3.65	3.77
3.89	4.00	4.13	4.26	4.37	4.51	4.65	4.79	4.92	5.07	5.21
5.37	5.53	5.68	5.84	6.01	6.17	6.35	6.52	6.68	6.87	7.06
7.25	7.45	7.65	7.85	8.07	8.27	8.49	8.71	8.95	9.18	9.41
9.66	9.91	10.16	10.43	10.69	10.97	11.24	11.52	11.83	12.13	12.44
12.76	13.09	13.44	13.79	14.16	14.52	14.90	15.29	15.69	16.09	16.52
16.95	17.38	17.85	18.32	18.79	19.30	19.80	20.31	20.86	21.41	21.97
22.54	23.12	23.71	24.30	24.88	25.47	26.05	26.58	27.10	27.58	28.05
28.43	28.82	29.13	29.44	29.68	29.92	30.13	30.30	30.44	30.57	30.67
30.76	30.83	30.90	30.93	30.97	31.00	31.02	31.03	31.04	31.04	31.04

REFERENCE LOT K FOR LOTS(P-Q-T-U). P.A. FIRING NO. 2

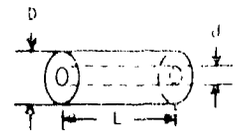
.37	.38	.38	.38	.39	.40	.41	.41	.42	.43	.43
.44	.45	.45	.46	.48	.48	.49	.50	.51	.52	.53
.55	.56	.57	.59	.60	.62	.62	.64	.65	.67	.69
.71	.73	.74	.77	.79	.81	.83	.85	.88	.90	.93
.96	.98	1.01	1.04	1.07	1.09	1.12	1.16	1.19	1.21	1.25
1.29	1.33	1.36	1.40	1.44	1.47	1.51	1.55	1.60	1.64	1.68
1.73	1.77	1.82	1.87	1.90	1.95	1.99	2.04	2.09	2.15	2.20
2.26	2.31	2.36	2.43	2.49	2.56	2.63	2.71	2.78	2.87	2.96
3.06	3.15	3.25	3.35	3.47	3.57	3.70	3.82	3.93	4.06	4.19
4.32	4.44	4.57	4.71	4.84	4.99	5.14	5.28	5.43	5.59	5.75
5.91	6.06	6.24	6.42	6.58	6.76	6.94	7.13	7.32	7.51	7.72
7.93	8.13	8.36	8.57	8.80	9.02	9.24	9.50	9.74	10.00	10.24
10.52	10.78	11.06	11.33	11.62	11.92	12.24	12.54	12.86	13.19	13.53
13.89	14.25	14.62	15.00	15.39	15.78	16.18	16.61	17.04	17.47	17.92
18.39	18.87	19.37	19.87	20.38	20.91	21.42	22.00	22.55	23.12	23.67
24.23	24.81	25.38	25.91	26.42	26.90	27.34	27.78	28.15	28.51	28.80
29.07	29.32	29.52	29.71	29.86	30.01	30.13	30.22	30.30	30.37	30.43
30.47	30.50	30.54	30.55	30.57	30.58	30.58	30.59	30.59	30.60	30.60

REFERENCE LOT K FOR LOTS(P-Q-T-U). P.A. FIRING NO. 3

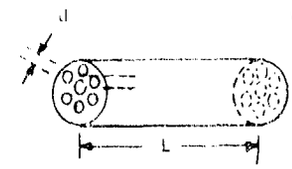
.36	.36	.37	.38	.39	.40	.41	.42	.42	.44	.45
.46	.48	.49	.50	.52	.54	.55	.56	.58	.60	.62
.63	.64	.67	.69	.71	.74	.76	.79	.80	.84	.86
.89	.92	.94	.97	1.00	1.03	1.05	1.08	1.12	1.15	1.18
1.22	1.25	1.29	1.32	1.36	1.40	1.44	1.46	1.50	1.55	1.59
1.64	1.68	1.72	1.76	1.80	1.85	1.88	1.92	1.98	2.03	2.08
2.14	2.19	2.25	2.31	2.37	2.44	2.52	2.61	2.68	2.76	2.85
2.94	3.04	3.13	3.23	3.34	3.45	3.55	3.66	3.77	3.90	4.02
4.14	4.26	4.39	4.52	4.66	4.79	4.93	5.08	5.23	5.37	5.53
5.68	5.84	6.01	6.17	6.35	6.50	6.69	6.87	7.05	7.25	7.44
7.64	7.84	8.05	8.25	8.47	8.69	8.92	9.16	9.39	9.63	9.86
10.12	10.38	10.64	10.92	11.19	11.47	11.77	12.05	12.36	12.68	13.02
13.36	13.69	14.05	14.41	14.79	15.18	15.57	15.98	16.39	16.81	17.24
17.68	18.13	18.61	19.08	19.57	20.09	20.61	21.13	21.67	22.21	22.78
23.34	23.91	24.46	25.02	25.55	26.06	26.54	26.99	27.42	27.80	28.14
28.45	28.75	28.99	29.20	29.39	29.55	29.70	29.82	29.93	30.01	30.09
30.15	30.20	30.22	30.25	30.27	30.29	30.30	30.31	30.32	30.32	30.32

PROPELLANT DRIED GRAIN DIMENSIONS

SINGLE PERF



MULTI-PERF



Prop-Perf	Sys	Chg	Ctg	L(mil)	D(mil)	d(mil)	W(mil)	Nominal Weight of 100 grains (oz)
M1 SP	105mm	M67		201.6(3.6)	45.8(1.1)	19.8(.53)	13.2(.71)	0.0242
M1 MP	105mm	M67		318.1(1.4)	142.1(1.5)	14.6(.32)	25.2(.40)	0.419
M1 MP	105mm		M393	435.2(3.9)	194.9(3.9)	16.6(2.2)	36.8(1.6)	1.105
M1 SP	155mm	M3A1		224.0(.94)	51.4(.63)	19.2(.60)	16.1(.38)	0.0358
M1 MP	155mm	M4A2		434.6(5.2)	192.8(3.3)	15.6(.70)	37.1(.90)	1.084
M1 MP	155mm	XM164		320.	142.	14.	24.	0.423
M1 SP	8"	M1		225.6(2.0)	50.5(.50)	18.9(.68)	15.9(.28)	0.0348
M1 MP	8"	M2		538.0(16.)	229.6(2.1)	20.6(.69)	42.0(.47)	1.804
M6+2 MP	76mm		M496	672.0	292.	31.6	50.1	3.7722
M6 MP	105mm		M327	369.3(1.6)	167.1(2.9)	17.0(.25)	29.4(.67)	0.686
M6 MP	155mm	M119		715.0(2.6)	308.1(1.3)	27.5(.50)	56.4(.50)	4.596
M6 MP	175mm	M86A2		1024.	439.	44.	77.	13.16
M10 SP	57mm		M306	144.1(2.8)	49.9(.87)	16.1(1.5)	16.9(.49)	0.0244
M26 MP	106mm		M344	515.2(3.9)	220.4(1.4)	22.4(.52)	38.7(.23)	1.707
M26E1 MP	152mm		M409	448.5(2.2)	200.6(2.2)	17.8(.40)	37.5(.50)	1.254
M30 MP	76mm		M339	791.8(5.7)	329.0(4.4)	32.4(.50)	57.5(.53)	6.093
M30 MP	90mm		M353	1036.3(11.)	438.1(4.9)	51.1(.74)	78.0(1.0)	13.72
M30 MP	105mm		M392	662.9(4.1)	277.4(1.4)	32.2(.42)	45.9(.48)	3.524
M30 MP	105mm		M456	782.2(3.2)	326.8(4.4)	37.2(.43)	53.6(.62)	5.795
M30 MP	105mm		M724	401.0(2.2)	169.0(1.3)	15.3(.92)	31.3(.74)	0.824
M30 MP	155mm	XM119		796.1(8.6)	330.7(4.8)	34.6(.55)	56.7(1.5)	6.13
M30A1*MP	155mm	XM201E1		783.4(6.9)	326.0(0.7)	35.6(.45)	55.3(.25)	5.82
M30A1*MP	155mm	XM203E2		943.9	421.3	34.4	80.3	12.18
M30A1*MP	155mm	Stick		29 inches	237.7(10.)	58.7(1.7)	89.3(4.6)	117.4
M30A1*MP	8"	XM188		1117.4(11.)	491.5(4.3)	48.1(.48)	86.1(.92)	19.21
M30A1*SP	105mm	XM121		288.5(3.4)	60.0(1.9)	20.5(1.6)	19.8(.86)	0.0700
M30A1*MP	105mm	XM121		627.5(19.)	265.4(2.0)	31.3(.42)	42.9(.60)	3.043
M30A1*MP	105mm	XM200		597.1(44.)	259.4(16.)	23.2(4.3)	48.0(3.3)	3.802

M8 Sheet 4.2 M36A1

Single Base: M1, M6, M10
Double Base: M8, M9, M26
Triple Base: M30 * W/1% lead carbonate

Nominal Densities (g/cm^3)

M1	1.55
M6	1.58
M10	1.67
M26	1.62
M30	1.68

Mean and standard deviation ( ) given for average values reported for about ten production lots.

Inner-outer web difference/web average for within lot variation varies from about -% to -13%.

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